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Protecting tea in Ceylon against Blister Blight using Cuprosana dust

VOLUME 6, No. 5 MAY 1954

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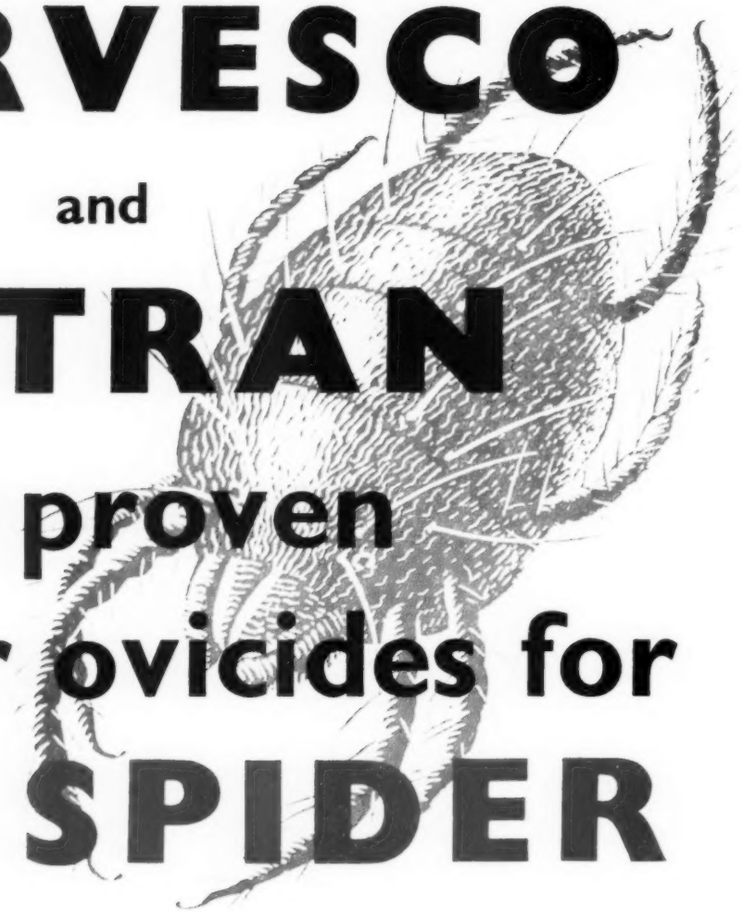

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Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

Vol. 6. No. 5 — MAY 1954

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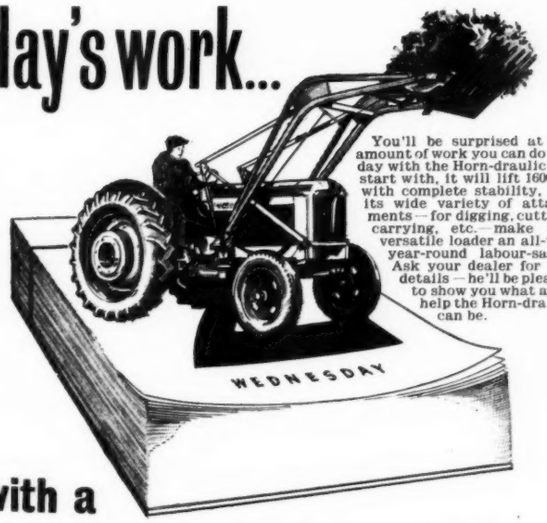

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Editorial Comment

World tea supplies

THE present issue of WORLD CROPS is mainly concerned with the tea industry in many parts of the world, and we would express our indebtedness in the first place to the numerous expert authorities who have contributed articles.

Tea, with its two sister 'beverage' crops, cocoa and coffee, has at the present time reached the zenith of prices that they have commanded on the world markets since they first started to be grown. Tea itself suffered some set back in price in 1952, chiefly by reason of over-production in North India due to excessively coarse plucking and a corresponding falling off in the quality of the finished product. With the correction of these defects by the North Indian tea planting interests prices recovered and the outlook for the industry appears to be moderately favourable.

It is noteworthy that in this regard the tea industry is more favourably placed at present than are some of the other tropical planting industries such as sugar, rubber, sisal, cotton and some vegetable oils which of late have suffered severe declines in market prices. The main reason for this seems to be that tea, in common with other food crops, is never likely to find itself in short demand provided that supplies are not excessive and do not greatly exceed the popular demand.

On the other hand, tea producers the world over confront serious economic problems. While it is true that tea prices have risen very greatly, production costs have also risen by a considerably higher percentage, particularly in respect of labour costs. Current ideas as to what constitutes a living wage and the extent to which the standard of living of the labouring classes in the tropics require and can economically be raised above pre-war levels are still undecided questions on which the utmost divergency of view prevails as between labour itself and the employers of labour. This conflict certainly seems less likely to be resolved on an economically satisfactory basis so long as the process continues of devolving the responsibility of government upon inexperienced and untutored representatives elected by some form of universal franchise by an even more uninstructed and untutored electorate.

The point that so frequently appears to escape attention is that if labour costs are forced by political agitation to excessive heights, it necessarily entails that the prices at which products can be sold must be increased proportionately equally to uneconomic heights at which a market for them may no longer exist, thereby involving the collapse of the industry upon which the population depends primarily for its existence.

Tea as a small holder's crop

IN an article in this issue the question of tea as a small holder's crop under Ceylon conditions is discussed. As a general proposition it seems not unlikely that as a result of the influences described in the preceding comment, it will become increasingly advocated in some quarters that the large-scale tea plantation varying in size from a hundred or so up to several thousands of acres should be superseded by groups of small tea holdings each owned and worked by a small proprietor.

In the light of this article it should be abundantly clear that if such a change should occur on a large scale the first result is likely to be the rapid diminution of tea production. It is unfortunately common experience with practically all tropical crops that when they are cultivated by peasants, returns normally fall far below the level experienced when the same crops are grown on an estate scale. The main exceptions to this rule have been in Fiji under the regime established by the Colonial Sugar Refining Company, where cultivation of sugar cane by a peasant tenantry has given returns comparable to those obtained under estate conditions, and under the regime set up in the Sudan for the cultivation of cotton under irrigation through the now defunct Sudan Plantations Syndicate. In both cases success depended on peasant tenants following rigorously the conditions for cultivation laid down by the authority, on pain of dispossession from their holdings if they did not comply with requirements in this respect.

In the case of tea, some sort of provision of this description would appear to be especially necessary if small holdings extend and the standards of production are to be kept up. Experience in Ceylon has shown that in many cases when peasant proprietors have assumed ownership of productive and flourishing tea properties, within a very short time standards of cultivation and levels of production have fallen almost beyond belief. It is easy to blame the small holder for this condition of affairs, but is it altogether fair to do so? By nature the native inhabitant of tropical territories is very averse to the expenditure of labour the need for which is not obvious, moreover he is often unversed and uninstructed in cultural practices the need for which are not obvious to him; an example is the intensity of plucking, it is often hard for a small cultivator to see that a conservative system of plucking may in the end lead to a larger return, there is also relatively small appreciation of the value of manuring. In Ceylon attention is being devoted to the improvement of small tea holdings by the instructional service of the Tea Research Institute inaugurated some years ago, which has for its aim the improvement of small holders' methods; in addition, the Ceylon Government is reported to be organising co-operative societies among small tea holders which will assist them in the financing of their industry, the procurement of supplies and the disposal of their produce. The provision in the former regard is believed to be small and could with advantage be extended.

Nevertheless, as the writer has said, in regard to other crops, it is doubtful how far small holding cultivation can become a success unless or until provision exists for the introduction in the last resort of an element of compulsion which can be used by means of appropriate sanctions to enforce the observance of the necessary standards of cultivation.

Mechanisation of tea cultivation

AMONG the articles in the present issue are two which deal with the possibility of mechanising tea cultivation, mainly with the idea of economising labour and thereby enabling cheaper production. At first sight the prospect does not appear very promising, inasmuch as although the possibility undoubtedly exists of introducing some form of mechanical clipper which will harvest tea, and which is carried slung over the shoulders of an operator in the field, its rate of delivery of plucked tea would have to be many times faster than that of the female tea pluckers who have usually acquired amazing rapidity and dexterity in plucking by hand, while in addition the question of motive power has to be solved either by some form of power unit electrical or petrol-driven carried by the operator, which adds considerably to his load, or by a centrally-operated power line installation with numerous off-take points into which such an apparatus can be plugged all over the tea estate, involving heavy capital expenditure and most careful supervision.

In existing conditions of tea cultivation, wherein the tea bushes are pruned into a flat table form it seems impossible to devise any wheeled form of mechanical plucker which can pass between the rows, and although much effort is being expended in attempts to develop forms of portable plucker which is carried manually by the operator, it seems probable that the ultimate solution may lie in the development of hedge planting in which the tea is grown in broad hedges with a curved top planted at a sufficient distance apart to allow the passage of implements which straddle the tea bushes and can be used both for plucking and pruning. Such a lay-out is bound to be expensive in the first place, since it must involve the uprooting and replanting of much established tea, but it seems not unlikely that it might enable the economy of large amounts of labour not only in plucking and pruning, but also in weeding, cultivating and the application of manures. Developments on these lines are being tried out in Northern India, and we also publish on another page an illustration showing how this hedge method of planting is being developed on the tea plantations of South Russia.

There is, however, this to be said in addition, that if methods of this type prove fully effective and are adopted on a wide scale in many parts of the world where tea is grown it seems inevitable that in the long run they may give rise to a widespread problem of unemployment, the solution of which may be hard to find and which will certainly tend to enhance the political unrest which is at present the cause and origin of so many difficulties.

Antibiotics and plant disease

THE use of antibiotic material for the control of fungoid and bacterial maladies of plants is becoming increasingly important. In America a number of instances have been reported in which various antibiotic substances have been used with success in this connection, notably by R. M. Goodman, who has used streptomycin and terramycin for the control of pear blight and peach bacterial spot in Missouri. Encouraging results are also reported to have followed the introduction of terramycin into the trunks of peach trees to control the attacks of the peach bacterial spot disease at the Plant Industry Station at Maryland.

In another connection encouraging results are reported from the induction of certain fungi for the control of various forms of root malady through the production of antibiotics. A recent example comes from the Rubber Research Institute of Malaya, where success in the control of the root disease of hevea rubber trees caused by *Fomes lignosus* is reported to have followed laboratory experiments in which it was grown in the presence of the fungus *Botryodiplodia theobromae*, the claim being that the production of an antibiotic antagonistic to *Fomes* has been established. If these results are shown to be capable of application in the field it may represent a notable development.

Altogether it seems that the plant pathologists are now beginning to move out of the age of dependence on lime, Bordeaux and Burgundy mixtures and to rival their entomological brethren in devising new and ingenious methods of dealing with plant diseases.

The annual British price review

THIS year's annual price review of economic conditions and prospects for the agricultural industry in the United Kingdom has just been completed and a White Paper, No. Cmd. 9904, has been issued describing the progress made by the agricultural industry during the past year, and giving an indication of the Government's intentions in regard to production and price policy during the same period.

It is satisfactory to learn that there has been a further expansion in the production of British farms during the past year which has played its part in ending controls and rationing. There have been large increases in the output of eggs, pig meat, calves reared and sheep. Crop yields, too, were an all-time record. This favourable result is in part due to propitious weather conditions, but nevertheless it reflects great credit on the hard work and skill of the British farming community.

In so far as price policy is concerned the Government has paid more consideration than in the past to market prospects, and for the first time the trend in costs is downward, and it is considered that although there have been increases in agricultural wages these have been more than offset by decreases in costs, particularly in feeding stuffs.

For 1953-54 the total net farm output is estimated to have been 56% above pre-war. While expansion of output to 60% above pre-war is still held to be a major objective, it is considered impractical and undesirable to set individual targets under the newly established free market conditions. The White Paper does, however, indicate the directions in which production should be developed in the immediate future.

The main directions in which the Government looks for increased production include:

(*a*) The production of more beef and if possible more mutton and lamb.

(*b*) The continued improvement of crop yields.
(*c*) The saving of food imports by the further extension of ley farming, including the improved and extended management and use of grass.

It is intended that agriculture in Britain should continue to receive the support from the Exchequer necessary for further development and maintenance in the future; but the cost to the taxpayer of the support at present given to British farming is regarded as very high, amounting as it does to about £200 million annually, and it is considered that progressive improvement in farming efficiency should provide a basis for the steady reduction in the cost to the Exchequer.

In accordance with this idea the Government proposes that while the production grants will be continued more or less on the present scale, there will be appreciable reductions in the price guarantees and the Exchequer liability. While there will apparently be no reductions in the guaranteed prices for fat livestock, wool, and hens' eggs (linked, however, to food prices) and sugar beet, there will be substantial reductions in the prices for pigs, milk, ducks' eggs, and cereals, while in the case of potatoes a support price will be substituted for a fixed price.

The farmer's viewpoint

THERE seems little doubt that the average British farmer will view these decisions with concern, if not with dismay. Farming memories are perhaps longer than some and many will remember the high hopes that were entertained of a safe and secure future for British farming after the First World War, and how the promises and undertakings then given were one by one removed under the clamant demand for economy, which found its expression *inter alia* in the exercise of the 'Geddes' axe and other economy measures, combined with the magnanimous, not to say quixotic, policy of British statesmen, in foregoing the debts which were owed to Britain by other European countries while attempting to honour to the full British indebtedness to the U.S.A. Small wonder is it, therefore, that the British farmer tends to see in these measures, due to a Conservative Government, the thin end of the same wedge which in the 1920s, under another Conservative Government, brought British agricultural industry, which had attained a position of prosperity and security during the years of the First World War, to the verge of ruin, from which it was only rescued by timely apprehension regarding the incidence of a second world conflict, followed later by the actual occurrence of this conflict in 1939 and the following years.

It is true that the Agriculture Act of 1947 does in essence offer guarantees that measures to sustain British agriculture will be maintained in the future, but it is small wonder that in the light of past events British farmers should feel some apprehension.

On the other hand, there is no doubt that hitherto British farming has not been altogether free from the accusation levelled at it by Mr. Stanley Evans of having been to an extent 'feather bedded,' and in a budgetary milieu hemmed in on the one hand by the clamant demands for defence and armaments, and on the other by the fabulous costs attaching to the social services which form part of the 'Welfare State' at once the pride and the joy of the Labour political party, it is small wonder that a harassed Chancellor should seek to effect some economies in the Government contribution to agriculture, which he justly points out should logically be capable of supporting them by the exercise of increased efficiency in farming operations.

We must remember that the National Agricultural Advisory Service, instituted under the 1947 Act, has only been functioning for seven years and that during that time it has won for itself the almost universal approbation and gratitude of the farming class. If it is maintained at its present level of efficiency there is no saying how far it may be instrumental in helping to bring about the further rise in the level of farming efficiency that is so urgently and so obviously needed.

Also it must be remembered that even after the new measures have been put into effect the level of Government aid to agriculture will be appreciably higher than that which prevails in almost all European countries this side of the Iron Curtain. It may not equal the Governmental aid to American farming, but even there we must remember that not withstanding the enormously greater size and importance of American agriculture the magnitude of the U.S.A. Treasury contribution thereto is not without its body of critics. On the whole, therefore, we are inclined to take the view that the present programme may find its justification in actualities, while sincerely trusting that farmers' apprehensions may in the long run prove to be without substantial foundations.

The education of the tropical peasant cultivator

OBVIOUSLY the education of the peasant cultivator is a subject of high administrative importance, and in many tropical countries efforts are in progress to bring about better standards of knowledge, education and technical attainment among peasant cultivators. There can be no common denominator in this connection since appropriate measures to secure improvement depend so much on the conditions at particular points, on the crops grown and on the sociological and economic conditions of the people themselves. Methods must, in fact, be fitted to the people and their environment. On the other hand there can be some degree of unification of ideas as to the aims which should be sought and the methods which have yielded the best results under a wide variety of conditions.

To assist in crystallising ideas in this direction and to provoke free discussion among colonial officers who are or will be associated with such efforts in the British tropical dependencies, the Institute of Commonwealth Studies of London University has recently organised a seminar dealing with various problems of peasant agriculture in the tropics; this took the form of a series of weekly meetings attended by teachers of the University, serving officers in the Colonial Dependencies at present on leave, students of many races at present undergoing training at universities and technical institutes in this country to fit them to occupy posts abroad

and experts on various aspects of tropical agriculture who have served for long terms in the British tropics and have now retired. Certain of these meetings the writer was privileged to attend.

The procedure adopted was to select a particular topic of importance in this connection such as soil erosion, the control of plant diseases or the effect of human diseases and health conditions on the efficiency of peasant agriculture, and to open the meeting with a short summarised statement by some acknowledged authority on the subject. Subsequently, the meeting was thrown open to general debate and finally, so far as possible, any striking points which had emerged were summarised. At the end of the session a review meeting was held at which the main conclusions were passed in review.

It cannot be said that any startlingly new conclusions emerged as the result of the seminar, but currently accepted ideas and views, as well as some newer and less orthodox ideas besides some current fallacies were brought out with great clarity; it seems inescapable that this method enables a gradual approach to greater uniformity of ideas and greater appreciation of the many difficulties inherent in this supremely important subject.

It can hardly be doubted that it is within the bounds of possibility that the influence of the seminar may extend further and be productive of more significant results than its original organisers foresaw. Certainly every credit is due to the Institute of Commonwealth Relations for the conception of the project and to Dr. W. F. Jepson, Reader in Entomology in the Imperial College of Science, who himself spent many years serving in the tropical overseas dependencies and acted as organiser and General Chairman of the seminar.

The Royal Society of Arts

THE Royal Society of Arts has recently celebrated its bicentenary for it was founded on March 22, 1754 under its fuller name, the Royal Society for the Encouragement of Arts, Manufactures and Commerce. The shortened title customarily used today probably leads many people to suppose that the Society's interest in science is a benevolent gesture of writers, painters and musicians towards the work of scientists, but this is totally incorrect. The older meaning of the word 'arts' is implied and the Society is in fact a body to encourage the practical application of scientific knowledge. Two years after its formation it was offering annual prizes for inventions. The harpoon gun, the world's first iron bridge, the Marsh test for arsenic and iron framing in ship-building are among the notable industrial advances sponsored by the Society's influence. But agriculture was far from neglected; with Arthur Young as a member of the Society's committee, farms were not overshadowed by factories during the great initial surging of Britain's industrial revolution.

The introduction of the swede and mangold into this country was principally due to the Society's efforts. Although Jethro Tull's drill had been invented almost 50 years before the Society's formation, the Society in its early activities did much to popularise its use. Seed drilling as opposed to seed broadcasting was first stimulated by the Society's awards to two experimental pioneers, Sir Digby Legard and the Reverend Lowther. A British reaping machine that preceded McCormick's reaper was undoubtedly encouraged by the Society's interest; indeed, this seems yet another case of original British ingenuity becoming the foundation of another country's better-known achievement. The Society failed in persistent efforts to establish a substantial silk industry in England, and another failure was the establishment of an agricultural research station, a venture strongly advocated by Young. It was never converted from idea into actuality for lack of a suitable Director, but had this difficulty been overcome Sir John Lawes' private initiation of Rothamsted would have been considerably anticipated.

From the middle of the last century numerous other organisations were actively stimulating the scientific development of agriculture, and the Society's own efforts perhaps became less outstanding. Nevertheless, as its annual programmes of lectures have always shown, the Royal Society of Arts has continuously fostered public interest in agricultural advances.

Iodine and crops

THE significance of iodine has been frequently debated. It is not considered one of the essential nutrient elements for plant-life; no evidence yet presented has established even trace essentiality. However, dogmatism on this point in regard to any element is unwise. In the past 30 years five and perhaps six elements previously dismissed as unimportant have been proved, by more delicate experimental work, to be indispensable. Nor is indispensability the only measure of virtue. As with sodium for some plant species, an element may be necessary for maximum growth without being essential for moderate growth.

New experimental evidence has emerged from the 1953 trials in Britain showing that free iodine, *not* combined iodine as an iodide, in very dilute solution is a most beneficial spray for young plants. It is not clear to what extent the iodine is absorbed by the plants. The effects obtained may be due or mainly due to the iodine functioning as a bactericide and fungicide. Immunity from damping-off, botrytis and wireworm attack is said to have been secured by spraying lettuce regularly—from the pre-sown seedbed stage to the planting-out stage—with an iodine solution of only 1/20,000 concentration. Similarly, tomato plants are claimed to have developed more sturdily and with freedom from damping-off, mosaic and *Cladosporium fulvum*.

This interesting research is to be continued this year. The conclusion drawn so far is that early treatment with these very dilute solutions of free iodine gives plants an environment more favourable to healthy growth and increases their resistance to subsequent disease. The fact that crops thus treated have matured as much as two weeks earlier may be due to these health factors rather than to any trace nutritional effect. An account of the results so far reported appeared recently in the *Fertiliser and Feeding Stuffs Journal* (1954, **40**, 5, 181-2). To what extent these experiments will be replicable in other seasons and sites remains, of course, to be determined.

The Tea Industry of the World

THE further development of the tea industry must be viewed against, on the one hand, the setting up of the International Tea Agreement and, on the other, the derationing of tea and of sugar as well as the abundance of milk in the United Kingdom, which is by far the most important market for Commonwealth exporters.

The International Tea Agreement

In so far as the International Tea Agreement is concerned, readers may be reminded that this was originally negotiated in 1933 between India, Ceylon and Indonesia (then the Netherlands East Indies) at a time when tea prices had fallen to uneconomic levels, and was designed to regulate supplies to the world's market at such a rate as would ensure that supplies would become available in such quantities as would ensure prices being maintained at economic values. The agreement has been renewed periodically since then and is now in its twentieth year, the last renewal having taken place on April 1, 1950. The main features of the agreement are (a) limitation of exports by quota, (b) prohibition of the expansion of the planted area, (c) regulation of the export of planting material. Until March 1941 the annual export quotas ranged between 82.5% and 95%; after that period exports from Indonesia ceased owing to Japanese aggression, after which date quotas were successively raised in order to maintain supplies at from 90% to 110% of the mean. During the post-war years the International Tea Committee have not attempted to restrict exports and those from the member countries have been consistently below the permitted export quotas.

World production

In continuation of the table in Vol. 3, page 293 of WORLD CROPS, the following gives the approximate figures for total world production of tea from 1938 to date in thousands of pounds, excluding China and Soviet Russia.

1938	1,070,090
1939	1,083,363
1940	1,124,462
1941	1,141,119
1942	1,197,590
1943	1,008,664
1944	963,744
1945	902,987
1946	969,122
1947	1,004,625
1948	1,035,976
1949	1,088,965
1950	1,283,000
1951	1,288,000
1952	1,280,000
1953	1,111,148

In WORLD CROPS, vol. 3, page 292, there appeared a review of the main features of the tea industry of the world up to and including the year 1949. In the following pages the progress of the industry since that year is summarised and brought up to date.

It will be observed that with the exception of the years 1950, 1951 and 1952 world tea production has not increased as compared with the pre-war years, and then only by relatively small amounts. This is mainly due to the decline in production in Indonesia, which in 1953 was estimated to have amounted only to 81 million lb. as compared with 184 million lb. in 1939.

On the other hand, production in India, Pakistan and Ceylon has greatly increased, having grown from 703 million lb. in 1939 to 1,196 million lb. in 1953. The peak of production was reached in 1951, since when production has evinced some tendency to fall slightly, largely due to restriction in plucking in the North Indian tea districts. Production in other Commonwealth countries in 1952 totalled 41 million lb.; new plantings are coming into bearing in British East Africa and Nyasaland, but production is reported to be hampered by labour shortages. Elsewhere Japan has recovered in production to almost the pre-war standard of close on 128 million lb., while Taiwan is in a comparable position, the production in 1952 having been estimated at 26 million lb., approximately equal to pre-war production. Among other foreign countries it is reported that production in the Soviet Union has considerably extended but no exact figures are available.

Exports

Exports of tea, which declined strongly during the war years and remained at about 75% of pre-war until 1947, rose in that year and in 1948 were about 90% of pre-war. In 1949 exports exceeded those of 1934-38 as rationing was abolished in some countries and stocks were rebuilt in others. Import demand was stimulated also by an increase in the consumer ration in the United Kingdom (December 1949). Prices rose by about 20% at Calcutta and Colombo auctions.

Prices

The year 1952 witnessed a considerable decline from the comparatively high levels of the previous year. The first, and probably most important cause, was the deterioration in quality, especially of Indian and Pakistan teas. Poorer grades usually tend to be more strongly affected by price recessions and the large proportion of low-quality teas in these countries greatly affected average prices. Secondly, buyers foresaw the possibility that to offset the rise in production costs estates would increase output per acre and that total supplies might exceed import demand. The slow and gradual removal of controls in the United Kingdom came too late to reverse the downward trend of the market. The subsidy of 8d. per lb. was removed by the British Government in March but it was not until July that the domestic ration was increased to $2\frac{1}{2}$ oz. per week. The second ration increase (to 3 oz.) was announced early in September and the long-awaited abolition of all restrictions on trade and consumption came into effect only in October. By that time Calcutta prices (for export) had declined by 45% from the levels of August 1951.

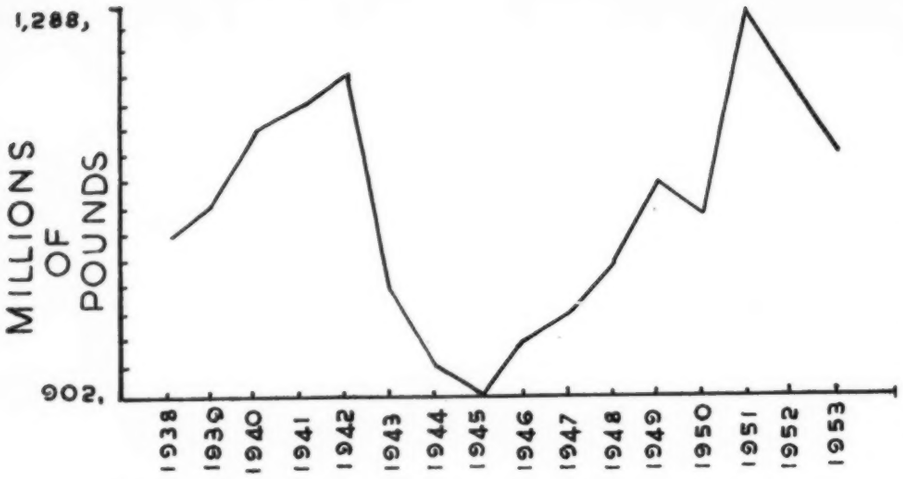
The closing of economically weaker tea gardens and the decision to reduce production by 8% had an effect on prices, which began to rise during the last months of 1952. The price of Calcutta export tea remained indeed very weak, but at Colombo average prices during the last six months were slightly higher than during the corresponding period in 1951. In London the recovery was quite marked. There was further recovery during the first months of 1953. Short of a major recession in prices of primary products, a comparatively high degree of price firmness for the balance of the year seemed to be indicated.

This prognostication held good throughout the whole of 1953 and the early months of 1954, during which time prices for tea on the London market continued to rise to very high levels. The following table taken from the *Financial Times* indicates the course of monthly prices up till February 1954.

Average Tea Prices Realised at London Auctions, 1953-54*

1953	s.	d.	1953	s.	d.
January	3	3.38	August	3	6.33
February	3	3.94	September	3	11.86
March	3	7.75	October	3	9.99
April	3	7.54	November	3	10.41
May	3	7.99	December	3	11.29
June	3	8.44	January 1954	4	1.53
July	3	5.53	February 1954	4	4.65

*Unweighted averages of all grades of tea sold. The prices are those realised on the last sale day of each month.



This diagram indicates variations in the world production of tea

Commenting on these figures the author of the article from which they are taken remarks that world demand for tea is now increasing and the outlook therefore would appear accordingly to be not unfavourable.

The rise in the price of tea is attributable to increased production costs and to the profoundly altered conditions which have come about in Asia during the past 10 or 12 years. Rice and other cereals have more than trebled in price while labour rates have risen to five times the pre-war figure. Production costs have probably quadrupled while, in addition, export duties have been introduced. So long as production costs remain about their present value it is hard to see how retail prices can possibly go down appreciably.

The outlook for the industry

While no fundamental change is to be anticipated in the course of the industry during the next few years, it is likely that they may witness some readjustments in the internal organisation of production. The rise in the cost of living and in wages is creating serious economic problems especially for estates in India, Ceylon and Pakistan. The high cost of labour is causing increasing insistence to become attached to the possibility of reducing labour costs by the introduction of labour-saving methods and appliances. The future may witness great and important changes in the methods of planting and harvesting tea in this regard.

To attain higher productivity per man-day it will be necessary to raise productivity per tree and per acre, and to investigate more carefully the possibilities of mechanisation of certain operations both from an economic and technical standpoint. The difficulties of mechanisation are well known, but those were at least as formidable in some other agricultural industries until the decline in profitability made mechanisation the only alternative to bankruptcy. Another measure to which tea producers may have to resort is simplification of the capital and management structure—amalgamation of small estates into larger producing units, reduction of overhead costs and greater reliance on supplies from peasant producers for processing by estate factories.

The production outlook in India, Ceylon and Pakistan will depend therefore almost entirely on economic factors—specifically on the relationship between production costs and prices. Production can be expanded greatly, both in the short run (through coarser plucking) and in the long run, through fertilisation, replanting with higher yielding varieties and through various cultivation practices. On the other hand, if prices decline to uneconomic levels output can be adjusted downward more easily than for many other agricultural commodities.

Exports

No substantial increase in exportable supplies is to be anticipated from Indonesia during the next few years. Numerous internal problems will have to be solved before production can increase. Nor are the prospects more favourable in Indo-China. Chinese production is rising from the low war-time levels but an increase in exportable supplies is likely to be channelled largely to the U.S.S.R. and Eastern Europe. In Japan, Taiwan and Malaya production is likely to rise slowly.

Outside the Far East, production prospects appear more promising. The total production of these areas is likely to remain below 35,000 tons in the near future, but somewhat greater increases may be in prospect in the more distant future. A trend towards increased production is visible especially in African territories. A large expansion is planned in the Belgian Congo; the Office des Produits Agricoles du Congo received government credits for the purchase of three manufacturing plants each of which will be able to handle 400 tons of tea a year and, eventually, up to 1,000 tons. In Mozambique both the tea area and the capacity of manufacturing plants have been increased since the end of the war. The area under tea which amounted to 5,177 ha. in 1944-45, rose to 10,200 ha. in 1950-51; the number of factories increased from six to ten.

Private capital has opened new tea areas in the British East African territories. Companies which formerly operated in India and Ceylon have started plantations in Nyasaland and Tanganyika. In the latter, climatic and soil conditions appear to be favourable and production is expected to double in the next five or six years.

Further production expansion is to be anticipated also in Latin America, Iran and especially in the U.S.S.R. Plans to make Iran self-sufficient in tea during the next ten years, which would require a 250% increase in production, have been formulated by the government, and the services of production experts have been made available under the UN Technical Assistance programme. Work on tea production is going on also in Brazil and Peru, etc. In the former country reports indicate an expansion of planting during the past two or three years and in 1951 Brazil exported a small quantity of tea to the U.S.A. Although no data on the U.S.S.R.'s tea area and production are available, both are believed to have risen substantially recently and further expansion is anticipated.

Conclusion

The major production increases in prospect are either for domestic consumption or in colonial territories (for local and metropolitan needs), and where labour and other production costs are even lower than in the traditional Far Eastern areas. Until now, competition on world markets from African supplies has not been an important factor. However, the development of production in new areas cannot be disregarded, especially in view of the consumption situation.

Acknowledgment

Acknowledgment is made of information taken from publications of FAO and the Commonwealth Economic Committee as well as from articles in the 'Financial Times' and information furnished by the Tea Bureau.

H.T.

Progress in the Tea Industry in North East India

C. J. HARRISON, O.B.E., B.Sc., A.R.I.C.

Outside China tea growing took its rise in North India. In the following article, the author outlines the development of the tea industry there. Mr. Harrison was formerly Director of the well known Tea Experimental Station at Toklai.

FOR over 100 years tea has been an established crop in North India. Before the end of the 18th century it was known that the tea plant would grow in India; indeed, in 1780, tea shrubs imported from China were growing in Calcutta. The East India Co., however, had the monopoly of the China tea trade, and it was not until 1833, when this monopoly had been lost, that active steps were taken to investigate the possibility of commercial tea culture in India, by the formation of a committee appointed in 1834 by Lord Bentinck, the Governor-General in Calcutta, the duty of which was to draw up a plan for the introduction of tea culture into India.

Early developments

The committee were aware that, in 1823, Major Robert Bruce and an Assamese, one Maniram Dewan, had discovered the tea plant flourishing in the Assam jungles, and that later Major Bruce's brother, Mr. C. A. Bruce, had had specimens of the plants identified by botanists in Calcutta as belonging to the genus *Camellia*. This identification was made on the leaves only, in absence of seed or flower. Later complete specimens proved to be of the true tea species, then named *Thea sinensis* (L) Sims.

As a result of the investigations of this committee tea plants and seed were imported from China and established in various localities on the foothills of the Himalayas, in Assam, in the Nilgiri Hills in South India, and later in the Dehra Dun and Ranchi districts. It was not long, however, before use was made of tea plants discovered in various parts of Assam, and in subsequent years the seed from such indigenous bushes was used extensively for planting out new areas, though some further importations of China seed and plants were made, especially for the hill districts of Darjeeling, Dehra Dun, Ranchi, Kangra Valley and South India.

In 1839 the Assam Company was founded—the first commercial tea company—and to this the Indian Government transferred its experimental areas of tea in Assam. In January 1839 the first consignment of Indian tea appeared at the London tea auctions. The eight chests comprising the 'lot' fetched prices varying from 15s. to 35s. per lb.—prices one suspects which reflected the novelty rather than the intrinsic value of the consignment.

Later expansion

In the latter half of the 19th century the culture of tea in North India expanded steadily. By 1900 there were over 200,000 acres under tea in Assam, and 75,000 in Bengal. The expansion which has taken place since then is shown in Table 1.

At the end of the 1938-39 season the total acreage under tea in North India was recorded as 677,894 acres. In the post-war years, North India (including East Pakistan) has produced over 500 million lb. of tea annually off approximately 700,000 acres.

The Indian Tea Association and its scientific department

The great majority of tea estates in North India were opened by British-owned companies, managed by Agency Houses in Calcutta. These firms in 1881 formed the Indian Tea Association, the object of which was to look after the interests of all companies and proprietary interests concerned in the production of tea in North India.

In 1900 the Association obtained the services of an agricultural chemist and the use of a small laboratory in the Indian Museum in Calcutta. Later an entomologist was appointed, with a laboratory

TABLE 1

Year	Assam		Bengal	
	Acres Cultivated	*Production in lb. millions*	*Acres Cultivated*	*Production in lb. millions*
1885/1889	211,301	67	73,169	19
1900/1904	338,250	141	136,153	49
1914	376,375	208	159,304	75
1924	412,849	237	181,833	87

Planting of young tea in hedges

in Cachar in South Assam, and a year or so later a chemical laboratory was established in the Jorhat district in Upper Assam. A mycologist was also appointed, and worked initially in Darjeeling on the fungus diseases of tea, notably blister blight (*Exobasidium vexans*, Massee).

In 1912 the present site of the experimental station at Tocklai in the Jorhat district was acquired, and has enlarged steadily until at the present time it comprises laboratories for the study of soils, agriculture, botany and plant physiology, plant pathology, and tea manufacture. In addition, there is a small-scale tea factory, an engineering branch, a tea tasting department, a small meteorological station, and a central office with library and advisory branch. Field experimental plots cover over 100 acres. In addition to a full staff of research workers, there is an advisory staff of four, two of whom work in Assam and two in North-West Bengal (Darjeeling, Terai and Dooars). These experts tour tea estates and advise the managers on scientific problems, and pass on to the planters the results of research at the central station at Tocklai.

A Darjeeling Estate—terraced tea in the background and medium-pruned bushes in the foreground

Culture and manufacture of tea in North India

Planting and cultivation

Until very recent years the tea plant has been established entirely from seed, grown in carefully tended and shaded nurseries, and planted out in the field when one to two years old. Estimates vary as to the economic life of the plant, but an approximate span of 45 to 60 years can be given for tea in estates on the plains.

Planting distances in the field have varied from 3 to 6 ft. apart, but the most popular distances have been 4 to 5 ft., at which spacing, under modern pruning systems, the plants spread rapidly, and in four or five years give an almost complete cover of the soil.

Hedge planting

In recent years, in view of the possible introduction of mechanical harvesting, pruning and other cultural operations, areas of young tea have been planted in hedges 5 ft. apart, with the plants 2 or $2\frac{1}{2}$ ft. apart in the hedges. Promising results have been reported, though until satisfactory mechanical methods of culture have been devised the full value of this form of planting cannot be assessed. Apart, however, from considerations of mechanical methods, hedge planting with its higher population density results in much higher early yields, and on account of the more rapid ground cover reduces the need for cultivation, compared with the older types of planting.

Early cultural practice

It was probably only natural that in the early days of tea the various cultural practices employed in the industry copied those of British agriculture—for instance, the indiscriminate use of lime and the insistence on frequent and often deep cultivation. On flat land in the plains, cultivation usually took the form of a ' deep hoe,' to a depth often of 12 to 18 in., in the dormant season, and several ' light hoes ' 4 to 6 in. deep in the spring and monsoon seasons, regardless of whether the soil was stiff or sandy, wet or dry. Soil stirring was considered of the greatest importance, and indeed was often employed on areas quite free from weeds, simply to ' aerate the soil.'

It was not until the scientific department, as a result of field experiments, had established the principles underlying the cultivation of a perennial crop such as tea that the removal of weed competition became recognised as the primary object of cultivation. In this connection the following observations* are of interest:

' All through the experiments which have been described the effect on the crop of keeping down weeds stands out in the most marked manner. Excessive growth of weeds leads extremely rapidly to enormous losses of crop; while on the other hand, increase in cultivation beyond the point at which jungle is practically suppressed leads to very small increases.

' There is some evidence that stirring the soil in the spring may do some good; and there can from first principles be little doubt that manure should be mixed with the soil and not left lying on the surface.

' Apart from these cases it appears clear that the stirring of the soil must be an extremely small factor in crop production compared to the suppression of jungle.

' . . . Jungle may be suppressed by other means than hand labour, and the most efficient and easily provided means of suppressing jungle is shade. The planting of shade trees and cover crops will reduce the necessity for cultivation; but the most directly profitable method is to increase the cover provided by the tea bushes.'

' Jungle ' referred to in the above extract is the term used colloquially among tea planters for weeds.

Cultivation on hill slopes

The problems of cultivation on hill slopes are, of course, very different from those of estates on the plains, due to the risk of soil erosion and the consequent need for soil conservation measures. Nevertheless, the basic principles remain the same—the suppression of harmful deep-rooting weeds and grasses, and maintaining as complete a cover of the soil as possible. Modern methods have progressed far from the original practices of planting up and down the slopes, deep and light forking, and restriction of soil cover by frequent and drastic pruning of

* 'The Cultivation Plots at Borbhetta,' H. R. Cooper and P. H. Carpenter, 1927, *Indian Tea Assn. Quarterly Journal*, pp. 153-157.

the tea bushes. Instead, contour planting, terracing, ' bunding,' green-cropping in contour lines, and the avoidance of unnecessary soil stirring, especially in wet weather, are common if not universal practices in cultivation on hill estates.

Shade trees, manuring and green crops

In the early days of tea there is no record of any regular manuring, nor was there an obvious need for it, since tea was for the most part put out on virgin forest soils. In time, however, such soils lost a great deal of their fertility under the combined influence of intensive cultivation and the weathering effect of the sub-tropical climate. This loss of fertility was quickly recognised by the agriculturists of the Indian Tea Association, and the use of oil-cake and cattle manure, of which there was a plentiful supply, was advised and applied with very satisfactory results. Later, as a result of detailed field trials, inorganic fertilisers, notably sulphate of ammonia, came widely into use on estates in the plains. Reference has already been made to the early and indiscriminate use of lime on tea. It was not then recognised that, though soils in the tea districts were in general acid in reaction, often extremely so, the tea plant is a calcifuge, and that applications of lime had no good effect, but might do harm. Undoubtedly one of the reasons for the general superiority of sulphate of ammonia over other forms of nitrogenous fertiliser for tea is its acid reaction in the soil.

Experiments failed to provide any evidence in favour of the use of potash or phosphatic fertilisers, either singly or in combination, on mature tea, though benefit was obtained on young tea up to five or six years old.

Shade trees of several leguminous species have been commonly planted on plains estates since 1880, when a planter in Assam, Colonel Hannay, called attention to the value of the ' sau ' tree (*Albizzia stipulata*), and another Assam planter, Mr. J. Buckingham, published a pamphlet on the subject of leguminous shade trees. Other species of shade trees which have found favour from time to time are various *Albizzias*, and *Dalbergias*, *Derris robusta*, *Erithryna indica* and *Cassia siamea*. Although the value of leguminous shade trees when used in moderation was generally recognised, in so far as their effect on the health and yielding capacity of the tea bush was concerned, there was a strong body of opinion, especially in Upper Assam, that shade was the enemy of tea quality. Experiments, however, showed that moderate shade was beneficial to quality, taking the season's teas as a whole. The use of short-term green leguminous crops in tea, once a very common practice, has for many years been almost entirely discarded in favour of longer-term crops such as *Tephrosia candida* and *Crotalaria anagyroides*, both of which have proved particularly valuable in young tea areas. They are generally interplanted in lines with the young tea plants, occasionally lopped, and removed after two, or at most, three years. The loppings form a valuable soil mulch, which protects the soil surface from wash during periods of heavy rain, assists in the suppression of weeds, and quickly decomposes under sub-tropical conditions to enrich the soil in humus and plant food.

Pest and disease control

Tea is liable to serious attack by a large variety of insect pests and fungus diseases. Moreover, the climate of North India can at times be extremely unkind to the cultivator — hail, windstorms, drought, floods, earthquakes and landslides have all in their turn taken severe toll of the tea crop. Among the many insect pests, tea in North India has suffered more damage from red spider (*Metatetranychus bioculatus* Wood-Mason) than from any other insect pests. In the early days the ' tea mosquito bug ' (*Helopeltis theivora* Wlk.) caused severe damage annually on estates in North Bengal and South Assam, but of recent years, especially since the introduction of DDT spraying, it has been regarded as of comparatively minor importance.

A field of plains tea with shade trees (*Albizzia odoratissima*) **in the background**

On the other hand, looper caterpillar (*Biston suppressaria* Green), practically unknown before this century, has of recent years been a familiar pest to most planters, and has been responsible for much damage to tea and shade trees. It is, however, susceptible to control by hand collection and by DDT spraying. In Darjeeling, thrips (*Physothrips setiventris*) does considerable damage to young tea shoots, and is difficult to control.

In addition to these major pests, there is a long list of minor ones, of which crickets (*Brachytrypes achatinus* Stoll.), white ants or termites (*Termes taprobanes* Wlk. and *Kalotermes* Sp.), pink and purple mites (*Phytoptus theae* Watt and *P. carinatus* Green), green fly (*Chlorita flavescens* Fabr.), scale insect (*Chionaspis theae* Maskell and *Lecanium* Spp.) may be mentioned, as well as several species of bark, leaf and stem eating caterpillars and aphids. The tea eelworm (*Heterodera marioni* (Cornu) Goodey) is a serious pest of tea seedlings, and has yet to be successfully controlled.

The tea plant has also always been liable to attack by various forms of fungal and algal parasites. In the early years of this century root disease decimated large areas of tea before the nature of the trouble was discovered and suitable control measures devised. Even at present constant attention needs to be paid to the control of parasitic fungi which attack tea roots.

Blister blight

Of the fungal parasites which attack the leaves of the tea plant blister blight (*Exobasidium vexans* Massee) has of recent years received much publicity on account of its alarming spread, and the damage it has caused, to the tea crop in South India, Ceylon and Indonesia. In North India blister blight has been known since the earliest days but has never developed to anything approaching the severity experienced in the other tea-producing countries, excepting perhaps in Darjeeling. The reason for the comparative immunity of tea in North India is mainly climatic, the long cold weather season causing a period of dormancy, during which the tea bush is usually pruned and denuded of its young vegetative growth on which blister blight develops. This is not the case in the other districts, where continuous growth throughout the year allows of a ' carry-over ' of infection to the following year.

The use of copper fungicides in spray and dust forms has proved of considerable value in the treatment of blister blight, but complete success is unlikely unless fungicidal treatment is combined with a readjustment of cultural conditions, par-

ticularly those of pruning, plucking and the control of shade trees.

Black rot

Probably the most serious fungus disease of mature tea in North India is black rot (*Corticium thea* Bernard and *C. invisum* Petch), which attacks and blackens both young and older leaves during the harvesting season when there is usually a dense mass of foliage on the bush. Regular spraying with a copper fungicide during the growing season, and clean pruning during the dormant period, have proved beneficial, but so far no satisfactory method has been devised for attacking the disease in its sclerotial stage on the stems of the plant, where the sclerotia are found in the lenticels.

Other serious stem diseases of tea are *Nectria* (the nomenclature of which is under review), and the algal parasite red rust (*Cephaleuros parasiticus* Karst.) which is a serious disease of young tea plants, and also attacks the green crop *Tephrosia candida*.

The plucking and pruning of tea

In North India the harvesting, or plucking, of tea takes place at seven- to ten-day intervals from roughly mid-April to mid-December.

The bushes are pruned during the dormant season (mid-December to mid-March) by cutting away the previous season's growth horizontally, and thereby forming a flat surface from which the new shoots arise. These are allowed to make about 10 or more inches of growth before being broken off to a measure from the pruning surface. This measure varies from 4 to 10 in., according to circumstances—it is usually 6 to 8 in. The plucked shoots, consisting of two or three leaves and terminal bud, comprise the ' raw material ' of manufacture. In the growing season the fields of tea on a well-plucked plains estate present the appearance of a vast level meadow dotted at regular intervals with feathery leaved shade trees. It is difficult to visualise the ragged appearance which must have been presented in the earlier days, when the tea bush was pruned to form a more or less dome-shaped surface, on top of which shoots were plucked at any length according to the whim of the plucker.

The fineness of plucking, that is to say, the number of leaves which with the stem and terminal bud, comprise the shoot harvested, determines to a considerable extent the quality and intrinsic value of the made tea. On many estates noted for the excellence of their teas, great attention is therefore paid to the leaf brought in from field to factory.

Women plucking a field of plains tea

The manufacture of tea

In the early days of the industry Chinese tea makers were brought to India to supervise tea manufacture and to instruct the local labourers, so that the process of manufacture, for the most part a hand one, followed closely that employed even today in the manufacture of China tea. As time passed, however, tea-making machinery was developed, *e.g.* rolling tables, sifting machines and dryers, and tea manufacture in India developed on its own lines, so that a product quite different in character from the China product has been developed.

After the introduction of machines for rolling, drying and sifting, no major change has taken place in the process of manufacture, which consists essentially in the following processes:—

1. Withering. In which the fresh shoots are spread out on racks for 18 to 24 hours, with the object of allowing them to lose some moisture and to become flaccid, in which condition they are easily twisted and bruised in the rolling process, with a minimum of smashing up.

2. Rolling. In which the withered leaf is subjected to a twisting and bruising action whereby its juices are partly expressed and so become subject to oxidation.

3. Green leaf sifting. To separate the finer and coarser parts of the shoots; the coarser part being returned to the rolling machine for further treatment.

4. Fermentation. The rolled leaf is spread on a clean cool surface and allowed to undergo an oxidation process.

5. Firing or drying. The fermented leaf is fed into drying machines and dried at temperatures ranging from 180° to 220°F. in a current of air.

6. Dry sifting and packing. The dried tea is sifted into the various grades, which are then packed in plywood chests for shipment.

The work of the scientific department chemists have been directed mainly to investigation of the chemical and biochemical changes involved in the various manufacturing processes, and to attempts to determine the optimum conditions for carrying them out.

Over 20 years ago the scientific department bacteriologist investigated the bacterial flora present on the tea leaf during manufacture. Many non-pathogenic bacteria are naturally found on the tea leaf, and some types may, given favourable conditions, develop to such an extent during withering, rolling and fermentation, that an adverse effect is produced on the quality of the tea. Methods have been worked out for suppressing such undesirable bacterial action.

Quality of North Indian tea

In the years immediately preceding the last war tea manufacture in North India reached a peak of perfection, due partly to the harvesting of fine leaf and partly to care and attention given to all details of the manufacture processes. Owing to slump conditions resulting from a world-wide over-production of tea in the years following the first world war, the industry, in 1932, became subject to a scheme of crop restriction. As a result of the 1939-45 war, however, India and Ceylon found themselves called on to provide the bulk of the world supply of tea, and crop restriction was lifted. Record crops were harvested, but with inadequate supervision and machinery quality suffered, and it is only within the last few years that a return to pre-war quality has been achieved.

Post-war progress

Much work has been carried out in the post-war years by the scientific departments in North and South India and in Ceylon, on the classification, selection and breeding of the tea plant; on soil and manuring problems; on modern methods of crop protection; on the chemistry of tea manufacture; and on mechanisation and modernisation of various cultural and manufacture processes, but reference to these post-war activities has purposely been omitted from this account as it is understood that they will form the subjects of other articles in this journal.

The Tea Research Institute of Ceylon

J. LAMB, M.Sc., F.R.I.C., A.I.C.T.A.
Director, Tea Research Institute of Ceylon

The Tea Research Institute of Ceylon was founded in 1925. Since then it has greatly expanded and has rendered invaluable services to the industry. The scope and character of its work are reviewed below by Mr. J. Lamb, its present director.

THE Tea Research Institute of Ceylon was founded by Ceylon Government Ordinance No. 12 of 1925. The revenue of the Institute has, since its inception, been derived from a cess on tea exported from the island. This cess, which was originally 10 (rupee) cents per 100 lb., has risen by successive amendments to the Ordinance and now stands at 55 cents which, if present crop levels are maintained, will yield an average income of just over a million and a half rupees a year. The tea industry of Ceylon therefore spends at present levels of prices about 0.2% of the gross export value of its tea crop on research.

Research on tea culture in Ceylon has proved a sound investment, for despite a half century of monoculture, yields have risen markedly in the past decade and the 1953 crop of approximately 340 million lb. was some 80 million lb. more than the standard export figure fixed for the purpose of the International Tea Regulation Scheme started in 1933. The steady rise in exports, without any significant increase in acreage or lowering of quality, leaves no room for doubt that a real improvement in yield has been achieved. At present prices this increase in yield is, at a most moderate estimate, equivalent to Rs.160 millions of additional domestic exports.

The origin of the organisation

The origin of the organisation set up for tea research in Ceylon is no doubt linked with memories of the disaster brought about by the coffee disease, *Hemeleia vestatrix*, which devastated the coffee plantations at the end of the last century. When the blister blight disease, *Exobasidium vexans*, was first reported in Ceylon in 1946 and began rapidly to spread across the tea plantation areas, fears of a repetition of the coffee disaster were widespread and the Institute became the guide, philosopher and friend of everyone connected with the tea industry in Ceylon. Fears were allayed by the assurance that the new disease could not cause such rapid deterioration as did *Hemeleia* on coffee. Recommendations for necessary changes in management, such as change in pruning season, to minimise the effects of the disease, were published and did much to counter the worst effects of blister blight attack.

Before research on control measures could be completed there was some disappointment at, and criticism of, the slowness of the scientific approach. Some years previously, control of the Tortrix caterpillar pest by the introduction of a parasite, *Macrocentrus homonae*, had been highly successful and there was some feeling of disappointment that a similar method of control had not been evolved for blister blight. By the end of 1950, however, a technique for control of the fungus by low volume knapsack spraying with copper fungicides had been worked out and a conference was convened for the purpose of disseminating the practical details. Doubts were at first expressed about the practicability of knapsack spraying some 200,000 to 300,000 acres every ten days throughout the monsoon, but these were quickly resolved and spraying is now accepted as part of the estate routine. Thus, the purpose of the foundation of the Institute based on the fear of plant disease has been justified in an almost spectacular way, and Ceylon tea planters are fully convinced of the value of scientific research.

Some of its achievements

In reviewing the achievements of the Institute tribute must be paid to the foresight of its founders in siting the laboratories and staff quarters in the heart of the tea growing district, especially for providing a commercial sized tea estate for experimental work and as a proving ground for new ideas. A loan of one million rupees, repayable over 25 years from the revenue derived from the tea cess, enabled the purchase of St. Coombs estate in 1928. Laboratories, staff quarters and a new tea factory were built on undeveloped land, leaving about 300 acres, including established tea, for cultivation. It has not by any means been easy to carry out large scale field and factory experiments and at the same time to compete successfully with neighbouring estates on commercial lines. In any case the experience gained has been of value to other similar organisations, but the necessity for careful thought on the subject of possible conflict between the experimental work and the commercial success of a plantation owned and operated by a research organisation is stressed. In the long run yields per acre and prices obtained for the products of a plantation managed by a research organisation have a profound

A general view of St. Coombs Estate looking east. The laboratories are situated on the hill behind and to the left of the factory. The shade trees on the hillside are *Grevillea robusta*. In the foreground is Guatemala grass planted on the contour

effect upon its status. 'Nothing succeeds like success' in the case of an Institute giving practical advice to planters.

Fortunately, the yield of St. Coombs estate in 1953 was 1,014 lb. of made tea per acre per annum as against a district estate average of between 700 and 800 lb. per acre, and the prices obtained for 'St. Coombs' tea have been outstandingly good. Commercial buyers of tea are extremely wary, and it has proved essential to convince them that all the teas sold under the name of St. Coombs estate have not been subject to experiment. Experimental teas are accordingly sold as such under a different 'mark.' Experiments with fungicides or insecticides liable to cause taints or 'off flavours' are regarded with great suspicion and at the height of experimental work on blister blight control, great difficulty was experienced with the sale of even the commercial tea from St. Coombs estate.

Practical bias of the research work

All research work carried out on tea in Ceylon has had a practical bias, no doubt largely due to the atmosphere of practical reality in which the staff live. The Board of Control also has a majority of practical planters and is advised by an estate and experimental sub-committee consisting largely of working planters and practising tea tasters. These conditions have not limited the publication of academic papers in scientific journals, but the Institute also publishes its own journal, *The Tea Quarterly*, which is primarily intended for the benefit of the tea planting community in Ceylon. That journal has a limited circulation outside Ceylon but is not difficult of access to other research workers.

Manuring tea

The relative values of the various lines of work undertaken are difficult to assess, but of the practical importance of the work on manuring tea there is no doubt. Very soon after the Institute was established field experiments on the use of fertilisers were laid down by T. Eden and have been of incalculable value. The main experiment comprising 54 plots, each of one-tenth of an acre, has three levels of nitrogen, three levels of phosphate and three levels of potash applications. The response to nitrogen has been evident from the early days of the experiment, but from the fourth pruning cycle onwards (approximately 12 years) a marked response to potash became evident and in recent years the response to potash has exceeded the response to nitrogen. Plots in which potash is omitted (K_0) are in some cases dying back and

TABLE 1

THE CONSUMPTION OF FERTILISERS

	Total Tonnage	*Percentage on Actual Sales Jan./Dec. 1952*	*Percentage in T.R.I. 500 Mixture*
Sulphate of ammonia	54,000	63	64
Ground rock phosphate (Saphos phosphate) ..	19,250	22	21
Muriate of potash	12,750	15	15
	86,000	100	100

TABLE 2

CARBON-NITROGEN AND ORGANIC MATTER CONTENT OF ST. COOMBS PATNA SOILS (4,500 FEET)

Period of Cultivation	*Carbon*	*Nitrogen*	*Organic Matter (Calculated)*	*Ratio C/N*
Nil (virgin land)	5·79	0.320	9.98	18.1
10 years	5·71	0.320	9.84	17.8
13 years	7·58	0.436	13.07	17.4
20 years	7·42	0.469	12.79	15.8
50 years (estimated)	6·31	0.468	10.88	13.5

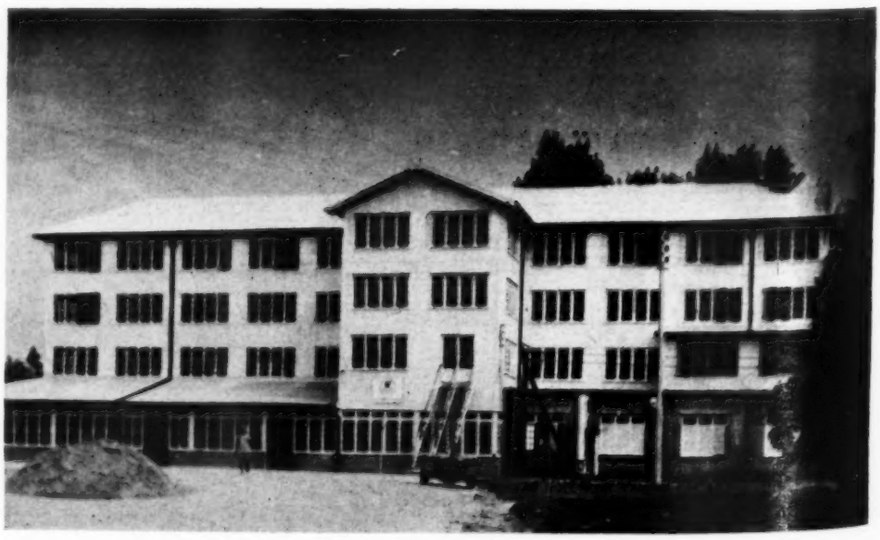
Portsmouth has reported the occurrence of potash deficiency symptoms.

Other experiments with different forms of nitrogen and phosphate, in some cases extended to sub-stations, together with extensive foliar analyses and accumulated experience have led to the recommendation of a standard manurial mixture for all tea growing areas in Ceylon. This mixture may be modified in the light of future experience, and experiments at sub-stations may well lead to variations of the mixture recommended for different districts or elevations, but in the present state of our knowledge the standard mixture, called 'T.R.I. 500,' appears to be giving highly satisfactory results. In general, application rates are based on yield and a table showing recommended application rates for crop levels ranging from 400 to 1,700 lb. per acre has been made available to all planters, visiting agents and agency houses.

Influence of the Institute on fertiliser use

Some time ago an assessment was made of the general level of manuring in Ceylon and of the extent to which the Institute's advice was being adopted. Ceylon fertiliser firms agreed to supply information about their sales of fertilisers to tea estates and the totals and percentages of the components of mixtures afforded fairly reliable data.

The total sales were also checked against the recommended application rates. For the purpose of rough calculation it could be assumed that planting companies, as distinct from small holders who use very little manure, produced approximately 300 million lb. of tea. For every 1,000 lb. of crop the use of 625 lb. of 'T.R.I. 500' mixture is advised. On this basis the industry should have consumed 84,000 tons



St. Coombs Estate commercial and experimental tea factory

of fertilisers and as may be seen from Table 1, consumption was actually 86,000 tons.

Although it was most gratifying to find that advice from the Institute is being so closely followed, the most interesting aspect of these findings is the complete replacement of nitrogen, phosphate and potash removed by cropping. Ceylon planting interests have adopted a highly advanced attitude towards the use of mineral fertilisers. The consumption of potash is, in particular, very high and judging from the figures published in the 34th report of the Commonwealth Economic Committee, is comparable to the consumption in the whole of India or the whole of Australia and is twice as much as the total consumption in New Zealand.

Fertilisers and tea quality

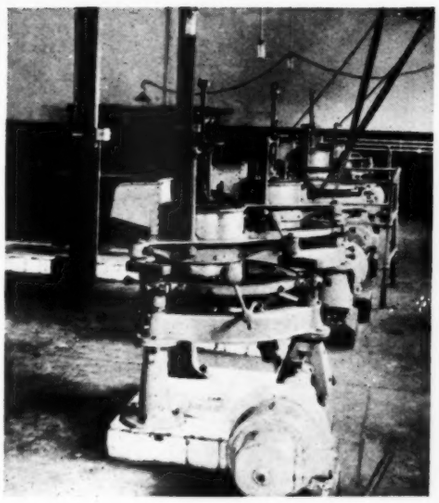
The consumption of fertilisers has been comparatively high for at least the past 20 or 30 years and has risen sharply since 1946. Parallel to this rise in consumption there has been a steady rise in crop levels as mentioned at the outset of the article. The effect of increased yields upon quality can only be judged by prices realised in competitive sales and in recent years Ceylon has rather more than maintained its position as a producer of quality tea. All the evidence obtained by comparative manufacture of leaf from the various plots in the manurial experiment support the view that increased yields obtained by the use of *balanced* fertiliser mixture have little effect on quality.

Maintenance of soil fertility

Experience of tea growing in Ceylon strongly suggests that the fertility of tropical soils may be maintained indefinitely by good management and the use of balanced fertiliser mixtures. It must be admitted that most of the data at present available apply to highland soils, for work has naturally centred on St. Coombs estate which is at an elevation of 4,500 ft. above sea level, but nothing contrary to this view has emerged from preliminary examination of conditions at lower elevations.

Eden in ' Monographs on Tea Production in Ceylon, No. 1 ' gives figures reproduced in Table 2 for carbon-nitrogen and organic matter content of St. Coombs patna (grassland) soils (4,500 ft. elevation).

Lamb, in work so far unpublished, has confirmed these results using both dry combustion and wet oxidation techniques for the determination of carbon and nitrogen and obtained similar results for jungle soils. Profiles examined down to 84 in. in



A battery of small-scale (experimental) rollers in St. Coombs factory

a field which has been in cultivation for at least 50 years, and in virgin jungle land alongside, show little comparative change except for the top few inches where the original superficial jungle mulch has become incorporated in the cultivated soil. Even at depths of 60 in. carbon contents may be as high as 1% and nitrogen 0.1%. This particular field is at present being replanted; young clonal plants were established without difficulty and are now growing vigorously.

The nutrition of the tea bush

Although progress in the practice of tea growing may be considered to be satisfactory, progress with the study of the nutrition of the tea bush is irritatingly slow. On apparently rich soils where the ammonium nitrogen remains constant at a remarkably high level of 5 to 7 p.p.m. down to a depth of 84 in., with a more variable, but high, level of nitrate nitrogen ranging from 7 p.p.m. in top soil down to 2 p.p.m. at 84 in., tea will respond to additions of as little as 20 lb. of nitrogen per acre in the form of sulphate of ammonia. Experiments with nitrogen applied as nitrate have indicated a poor response to nitrate and this has been confirmed in other tea producing countries. Low nitrification rates in the acid soil which tea demands, may be expected to limit the amounts of nitrates formed in such soils. Lysimeter studies are, however, giving most conflicting results. Mature bushes in soil containing up to 14 p.p.m. of ammonia and receiving a regular addition of all nutrients except nitrogen and molybdenum, are showing every sign normally associated with nitrogen starvation. The nitrate content of the soil in which mature bushes are growing is lower than in the soil of the controls (soil only) and the drainage from the soils in which bushes are growing regularly shows less nitrate than the drainage from the controls.

Minor and trace elements

The supply of minor and trace elements in Ceylon tea soils appears to meet all the needs of the tea plant. The saphos phosphate and the muriate of potash used in fertiliser mixtures are in any case an apparently adequate source of supply of minor and trace elements. Tea appears to have a very low requirement for molybdenum, which is of special interest in view of the studies of nitrogen nutrition. Whereas legumes rapidly take up molybdenum applied to tea soils, tea bushes show no such increase and in fact it has not been found possible by any of the usual methods of chemical or micro-analysis definitely to establish the presence of molybdenum in Ceylon tea.

In view of the deficiency condition known as tea yellows, sulphur is also of particular interest. Storey and Leach corrected sulphur deficiency conditions by application of sulphate of ammonia to tea in East Africa. In pot experiments in Ceylon, in which nitrogen is added both as ammonia and nitrate with, and without, sulphate, growth has so far been normal except for a remarkable susceptibility to chloride scorch in the absence of sulphate.

Other achievements

Other achievements and activities must be reviewed more briefly, not because they are of less importance, but mainly by reason of lack of space. Some reference has already been made to the critical period which followed the appearance of blister blight in Ceylon, and if it had not proved possible to bring the disease under control practically all the tea in the south-west montane zone, comprising the greater part of the Ceylon acreage, would have deteriorated to a level where working would have become uneconomic.

Plant pathology

The pathology department which at present includes work on both mycology and entomology has a tradition of service to the planter. Plant diseases are puzzling to the layman who often finds difficulty in distinguishing even between fungus and insect attack. With the wealth of proprietary fungicides and insecticides which have become available in the past few years impartial guidance is essential. Petch and Gadd in turn guided the activities of this department on sound lines and with the exception of shot-hole borer (*Xyleborus*

A control charge unit used for recharging knapsacks in spraying against blister blight with four spraying labourers in the background

fornicatus fornicatior) control measures have been devised for all the economic pests and diseases of tea in Ceylon. Nematodes, especially the meadow eelworm (*Pratylenchus pratensis*), have been causing increasing concern but Loos, following Gadd and Loos, has achieved some initial success in the selection of tolerant material for clonal propagation.

Complementary to field trials on manuring, the physiology department has undertaken many experiments on bush management. Tubbs showed that the stores of carbohydrate essential for recovery from pruning vary directly with elevation, and that under the warmer conditions of the low country, dieback after pruning is a physiological effect due to low carbohydrate reserves. The remedy for this condition was found to be lighter pruning or rim-lung pruning, in which the leaves left on the bush are sufficient in number to avoid exhaustion of carbohydrate supplies.

Plucking and pruning

With a crop such as tea, in which the harvest is foliage and not fruit or seed, strict management of plucking and pruning is essential. To a large extent all field experiments tend to the conclusion that yield in any one pruning cycle is directly related to the maintenance of foliage and frame. An experiment designed to demonstrate the effects of over-plucking has shown a steady deterioration in both yield and condition. Work on the improvement of tea started by Tubbs and enlarged upon by G. B. Portsmouth in this issue of WORLD CROPS is destined to play a large part in future programmes of work.

Processing and preparation

Tea leaf once harvested becomes the responsibility of the biochemical cum technological department. Since the quality, especially of high grown Ceylon tea, is a most important feature of Ceylon teas, the activities of this department have always been regarded as being of the greatest importance. In the broadest sense of the word, quality involves conformity to all food and drug rules and regulations and much work has been devoted to minimising contamination by heavy metals and to hygiene. In the narrower sense, work on quality involves the maximum development of inherent properties such as colour, strength, pungency and flavour during the course of manufacture. The tea trade attaches such importance to the appearance of the manufactured grade of tea that usually attempts to change radically the traditional methods of manufacture have ended in failure. Since all experiments are finally dependent on tea tasters' opinion and since no other method of measurement of quality has proved feasible, experiments on tea manufacture are liable to be lengthy and confusing.

In general it has been shown that the level of quality is primarily determined in the field and that improvements in tea manufacturing processes must, therefore, be aimed at standardisation of methods and reproducibility of results in order to minimise the loss of inherent quality. Studies of factory organisation, improvements in the control of processes such as rolling, fermenting and firing, and studies of the mechanics and efficiency of rolling have all resulted in steady, if unspectacular, progress.

Soon after systematic research on tea manufacture was started in Ceylon it was realised that before any real understanding of the process of tea manufacture could be achieved a study of the chemistry and biochemistry of the green leaf and the changes taking place in manufacture were essential. A joint scheme between tea producing countries enabled Bradfield, working in London, to demonstrate the presence of several different catechins in the constituents formerly called 'tannins.' During the course of manufacture these catechins are rolled out of the leaf by a lengthy process taking up to three hours and undergo enzymic oxidation to substances which contribute largely to the colour, strength and pungency of the tea liquor as consumed. Lamb, Sreerangachar and Ramaswamy have, over a number of years, studied this enzymic oxidation first showing that the primary oxidation is due to a polyphenol oxidase and later (unpublished except for annual reports) that the rate of reaction is influenced by a pectase which liberates pectic acid from the rich supply of pectins in the leaf. The optimum temperature and reaction rates for polyphenol oxidase and for pectase activity are widely different and a way has been pointed to more effective control of fermentation. With better understanding of the fundamentals of manufacture, an urgent need has arisen for the services of an engineering department to assist with factory experiments. These facilities have now been provided and provision made for further assistance with technological development. It is anticipated that a period of relatively rapid progress lies ahead.

Photos: Tea Research Institute of Ceylon.

Appointment for Sir Frank Whittle

Air Commodore Sir Frank Whittle, the British pioneer in the field of jet propulsion, has taken up an appointment with the Bataafsche Petroleum Maatschappij (B.P.M.), of The Hague, which is one of the principal operating companies of the Royal Dutch/Shell Group.

In his present assignment Sir Frank will give advice in the field of mechanical engineering relative to the development of techniques and equipment in the petroleum and chemicals-from-petroleum industries.

Mechanisation in the Tea Industry in Northern India

R. J. McILROY, Ph.D., F.R.I.C., *Director*, and
P. M. GLOVER, M.B.E., B.Sc., *Senior Advisory Officer*
Tocklai Experimental Station, Assam

The mechanisation of tea growing is becoming a matter of importance as a result of rising labour costs. The manner in which the problem is being tackled in Northern India is described below.

TEA employs more labour per unit area than any other large-scale crop. The average number of labourers per acre on a well-found garden in Assam is in the vicinity of 1.5. The figure for North-East India as a whole is rather lower than this, falling very close to 1.0. In the past, labour on tea estates has been cheap and plentiful; in recent years, however, following the world-wide trend towards improved living conditions, wages have risen steeply, and coupled with this there has been a corresponding amelioration of housing conditions and additional provision of medical facilities, all of which have increased labour costs considerably. Labour, and the cost of concession foodstuffs, are today much the *largest* item in the cost of tea production, amounting to something like 40% to 50% of the total expenditure. Implementation of the Plantation Code (at present in abeyance) is under consideration. This will result in a further increase in cost of labour.

The Indian Tea Association, alive to the importance of mechanisation, called upon Mr. D. W. Tull, a well-known consulting engineer, in 1949 to advise as to the scope for mechanisation in the tea industry and as to the need for a permanent engineering department at their research station at Tocklai. As result of Mr. Tull's recommendations Tocklai now has its own engineering department and resident engineer and the necessary facilities for the designing and construction of prototype machinery.

Labour in factory and field

The amount of labour employed in the factory in the manufacture of tea is very small when compared with that employed in cultural work in the garden. The percentage of the total labour force working in the factory in all capacities averages only about 9% to 13% of the total labour force employed.

It is clear, therefore, that while a saving in labour costs in the factory is most desirable, a far greater saving would result from mechanisation in the field, and it is in this direction that we should devote our maximum effort.

In a tea garden the tasks at present carried out by hand are many, those of major importance being the following:

(1) Plucking.
(2) Cultivation.
(3) Pruning.
(4) Manuring.
(5) Nursery preparation, and planting of tea and shade trees.
(6) Transplanting of tea and shade tree seedlings and plants.

Plucking

Of all these tasks plucking absorbs the largest amount of labour. For example, it takes on an average five women to pluck one acre of tea in an eight-hour day. The plucking season in North-East India is from mid-April to the end of November. Approximately 50% of the total tea crop, however, is harvested in the three months August, September, October. Most North-East Indian tea estates employ, therefore, sufficient resident labour to pluck their crop during these three months.

If they did not do so, they would be compelled to leave some of their tea out of plucking during these heavy flushing months. Casual labour, even if available, is not prepared to work during these months as they coincide with the planting of the staple food crop, rice. Resident labour must be paid throughout the year and on many estates in the non-peak months it is difficult to find work for this surplus labour to do. The problem of field mechanisation is dependent, therefore, upon mechanical plucking.

Mechanical plucking

Mechanical plucking presents a number of difficult problems. The majority of the tea in North-East India is planted at

A section of high-yielding tea, planted 4 ft. 3 in. by 4 ft. 3 in. triangular in 1941, under *Albizzia odoratissima* shade. The difficulties involved in plucking such tea mechanically are clearly seen, and this is typical of high-yielding tea as at present planted in many gardens in Assam

spacings varying from 4 ft. by 4 ft. square to 4 ft. 6 in. by 4 ft. 6 in. triangular. When mature, at about 10 years old or earlier, the tea bushes meet, forming a complete canopy over the ground, through which it is possible to push one's way only with difficulty. A section of tea once planted is good for 40 to 50 years or more. Tea is grown on ground which is not necessarily flat or even level. It may be grown on hillocks (teelas) or on slopes which in some districts are very steep. It is almost invariably grown under the shade of leguminous trees, which may be spaced at distances which may vary from 36 ft. by 36 ft. to 45 ft. by 45 ft., square or triangular. In most sections there are main and subsidiary drains which may be anything between 1 ft. and 3 ft. in width. In plucking, complete tender shoots of two leaves and a bud must be taken, without damaging or bruising them and without hard leaves and stems being gathered if good quality tea is to be made. At each round bushes must be plucked at a pre-determined height which should be $\frac{1}{4}$ in. approximately above the level of the previous round.

Five women can pluck an acre in an eight-hour day to this rather exacting standard, which means that a woman can pluck a tea bush selectively in about $\frac{1}{2}$-$\frac{3}{4}$ of a minute. Plucking rates for 1954 have not been finally agreed upon, but working on a basis of two women per maund of green leaf (80 lb.) plucking will cost in the neighbourhood of Rs. 4 (6s.) per maund. A maund of green leaf (80 lb.) gives on manufacture about 18 lb. of made tea, which will mean that plucking costs amount to $3\frac{1}{2}$ annas (or roughly 4d.) per lb. of made tea. This then, sets the standard by which any mechanical plucking machine must be judged. It should also be borne in mind that a woman not only plucks and collects the leaf that she plucks, but also transports it to the weighing site.

Drawbacks of hand-carried machines

Hand-carried mechanical plucking devices developed to date are no faster in action than hand plucking, are much less selective, and do not result in any reduction in labour. The weight of such machines is tiring to the operator who cannot maintain a steady level of plucking. The power operation of hand-carried machines also presents difficulties. A petrol motor or a battery in a pack on the back is not popular with labour and is open to a great many other objections. Electrification from a generator is difficult due to the length of cables required and the wear and tear on them, to say nothing of electrical troubles arising from their constant use in wet weather. The heaviest flushing months, July to September, are also the wettest months of the year in North-East India.

Wheeled machines

It appears to us essential to employ for mechanical plucking a power-driven machine on wheels or tracks straddling one or more lines of tea bushes. Such a machine *must* be capable of both pruning and plucking. The pruning table, and later the plucking table, will not necessarily be flat as at present but will follow the configuration of the ground with which it will be parallel. Several methods by which inequalities in the ground surface could be 'ironed' out so that the cutting head remains level suggest themselves:

1. To run the machine on light rails would be satisfactory as preliminary trials at Tocklai have shown. It is, however, certain to be very expensive. A rough calculation of the cost of light rails running between every line of tea bushes in any one direction gives a figure of Rs. 9,000 (£675) per acre. If the machine were to cut two lines of tea bushes simultaneously the cost of rails would, of course, be approximately halved.

2. The use of tracks or a chain of individually sprung wheels would go a long way towards maintaining the cutting head level, though in practice the damaging effect of tracks on the ground surface and the complication of a train of wheels might outweigh their advantages. It might be necessary to lay single line brick or cinder paths over which the tracks or wheels would run.

Such methods may appear expensive, and so they are bound to be initially. Against this must be set the ever rising costs of labour, and the fact that these costs are both increasing and recurring.

A logging arch type machine spanning a single line of tea bushes, self propelled, running on rubber-tyred wheels, has been designed by Mr. D. W. Tull, consulting engineer to the Indian Tea Association. A prototype is under construction in the United Kingdom and it is hoped that it will reach Tocklai in time for trial and experiment in the coming plucking season.

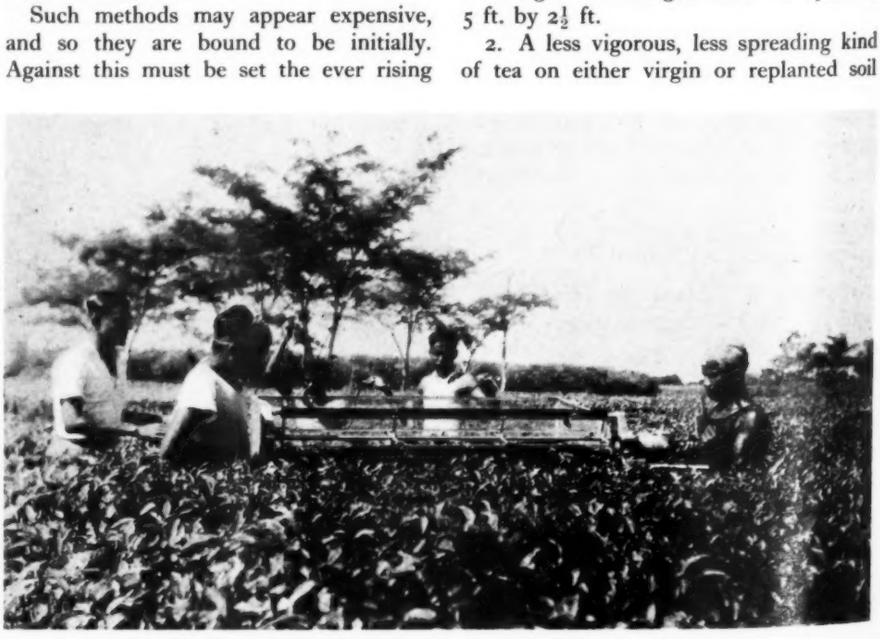
The close formation of triangular and square planted tea does not facilitate the passage of wheeled or tracked vehicles. It was for this reason, combined with the rapid ground cover and the high initial yields obtained, that Tocklai published Memorandum No. 21, 'Hedge Planting of Tea,' as long ago as 1949.

Hedge planting

It is suggested that all future planting of tea be in the form of hedges. Spacings which appear suitable are for single hedges 5 ft. by 2 ft. or 5 ft. by $2\frac{1}{2}$ ft., and for double hedges 5 ft. by $2\frac{1}{2}$ ft. by $2\frac{1}{2}$ ft. Single hedges give a maximum plucking surface of 5 ft., double hedges a maximum plucking surface of 7 ft. 6 in. In the former case the track width of a logging arch type of machine would have to be 5 ft., in the latter 7 ft. 6 in., assuming that only one hedge at a time is cut. The actual spacing selected must depend to some degree at least on the vigour of the tea, and on whether the soil is virgin or is a replanted area. As a guide the following spacings are suggested:—

1. Very vigorous, spreading kinds of tea on virgin soil might best be planted 5 ft. by $2\frac{1}{2}$ ft.

2. A less vigorous, less spreading kind of tea on either virgin or replanted soil



Early experimental work with a large man-handled Tarpen mechanical tea cropper at Borbhetta, the experimental tea garden at Tocklai

A typical area of young hedge-planted tea, put out in March 1949 5 ft. by 2½ ft., photographed in December 1949. Between the hedges of young tea plants a leguminous green crop (*Tephrosia candida*) has been grown along the 5 ft. gap to provide shade for the young tea, suppress weed growth and as a soil improver

might be spaced at 5 ft. by 2 ft. or 5 ft. by 2½ ft. by 2½ ft.

In hilly sections or on sloping land the hedges should follow the contour. This is in itself highly desirable as a measure of erosion control.

Shade trees and hedge planting

'Permanent' shade trees are best planted within the tea hedge by omission of a tea bush. In such a position they will offer the least obstruction to logging arch type machines which, of course, would not be able to pluck in a continuous cut the hedge line in which the shade is situated. If planted between rows, shade would obstruct the plucking of two hedges instead of only one using this kind of machine. The hedges in which the shade trees stand (every seventh hedge where the shade is spaced at 40 ft. by 40 ft.) might be plucked by hand. As an alternative, the tea in every seventh hedge might be uprooted and the spaces so left used as inspection and leaf collection paths. Temporary shade can be planted in between the tea hedges as such shade would in any event be due for removal at, or just before, the time that mechanical plucking could be started.

To omit shade is not an economic proposition. Shade sufficient to reduce the light intensity to between 70% and 50% of that of full sunlight, and without the use of fertilisers will double the yield of unshaded unmanured tea with no loss in quality. Maximum yields are obtainable by judicious use of fertilisers combined with such shade.

In the first two years a leguminous green crop may be grown down the centre of the 5-ft. gap between the hedges, just as is done in 4 ft. by 4 ft. square or 4½ ft. by 4½ ft. triangular planted tea, at present, to act as shade for the young tea plants and to suppress weed growth. The hedgings and loppings from this green crop form a most valuable addition to the soil humus, as does the green crop itself when it is finally cut down.

Cultivation

A further advantage of hedge planting is that, if it is so desired, cultivation in early years can be carried out mechanically with a rotary hoe. Where this is the practice the green crop should be offset to one side of the gap so that there is room for the rotary hoe to cultivate between it and the young tea.

To allow the free passage of mechanical plucking machines of the type envisaged, it will almost certainly be necessary to head back lightly lateral branches of the tea bushes on either side of the gap in which the wheels or tracks are to move. This will entail some *small* loss in crop, a loss which is justifiable in view of the high yields obtainable from hedge-planted tea.

Once such a machine is designed, it may be used for many purposes other than plucking. Operations which we envisage as falling within its capabilities are:

(*a*) Pruning, by substitution of a suitably modified cutting head.

(*b*) Cultivation, by means of a rotary hoe attachment.

(*c*) Fertiliser distribution using a suitable attachment.

(*d*) Spraying, using a 'Plantector' type attachment.

It should frequently be possible to carry out two operations simultaneously, for example, plucking and cultivation could easily be combined.

Selectivity

Whether a machine can be designed which will be really selective is problematical, and it seems probable that mechanically plucked leaf will not be of the same standard as that produced by *really good hand plucking*. It should be stressed that by *no means all* hand-plucked leaf is of a high standard. The maintenance of good hand plucking is no easy task.

Experiments with machines made available to us indicate that, provided these are correctly designed, a fair degree of selectivity at least, will be practicable. However well a woman may pluck, the plucking table so formed is not by any means level. Preliminary trials with machines where a dead level plucking surface has been maintained (as, for example, with rails) suggest that with repeated mechanical plucking the actual standard of leaf plucked improves. This may be due to a more even growth response by the tea bush to a dead flat level of plucking.

In any event should mechanical plucking produce a small percentage of poor leaf, it would be possible to counteract this by minor modifications of factory procedure, which might include mechanical sorting of the green leaf either before or after withering.

Preliminary results with *hand-carried* plucking machines indicated that there might be some loss in crop, under mechanical plucking as against hand plucking. It is possible that such losses may have been occasioned by failure to maintain a level plucking table with hand-carried machines due to their weight causing fatigue to their operators. This has been referred to earlier in this article. Any such losses must be balanced against the increased yields from hedge-planted tea, and in any event losses may have to be accepted in view of the ever increasing costs of labour.

Progress in other directions

In other respects mechanisation in the field is already making satisfactory progress. Many gardens use a rotary hoe to cultivate young tea and for the preparation of nursery sites. Ploughing and harrowing of land in preparation for planting, using a tractor, is standard practice on most gardens. Uprooting of old and worn out tea by tractor and winch is already replacing the hoe and the elephant for this purpose. The transport of leaf by lorry, tractor and

Uprooting a section of old worn-out tea in Assam by means of a Fordson tractor and winch prior to preparing the land for replanting

trailer or trolley line, using a diesel engine, and leaf trollies from field to factory is usual on most gardens, where this distance is large.

Drain construction and the cutting of trenches mechanically for the planting of hedge-planted tea are likely in the near future. Suitable machines are already on the market.

Sowing of tea seed

Sowing of tea seed could very easily be carried out mechanically. There are, however, a number of practical disadvantages to planting seed at stake in North-East India. The major of these is the difficulty of keeping weed growth in check over a large area under monsoon conditions, particularly if a leguminous green crop is not established several months prior to sowing the tea seed. Further, the cricket, *Brachytrypes achatinus*, occurs in numbers in some districts and causes considerable damage to young tea seedlings. It is not easy to control this cricket where large areas of many acres are planted. It is agreed that such difficulties are not insurmountable and as mechanisation proceeds it may become necessary to plant seed at stake.

The normal practice is to sow tea seed in nursery beds where the young plants can receive thorough attention, and from which they are transplanted, usually at one year old. In Assam, planting of one-year-old tea plants, carrot fashion, has not not proved satisfactory. The usual practice is to lift the plants with a cylinder of earth round the roots of 5 in. diameter and about 10 in. long, weighing 10 to 12 lb., and to plant them in previously prepared pits or trenches, from which the spoil has been removed. The young tea plant with its roots in this cylinder of earth is placed in position in the pit or trench; the spoil is then returned and is well rammed. The weight of the plants and the cylinder of earth surrounding the roots and the need for ramming preclude the use of any mechanical transplanter at present on the market.

Mechanisation and unemployment

Mechanisation cannot be considered without reviewing the position in relation to the livelihood of unskilled labour at present employed on gardens. In the authors' opinion there is not the slightest fear of mechanisation resulting in an unemployment problem. We believe that mechanisation of plucking will be a very gradual process and that it will be largely dependent upon the replacement of square and triangular planted tea by hedge planting. By this we do not suggest that existing areas of square or triangular planted could not be modified by heading back the sides of bushes to permit the passage of machines, but that hedge planting will greatly facilitate mechanical plucking. It is on high yielding hedge-planted tea laid out on favourable ground that mechanical plucking is likely to give the best results.

The outlook

The amount of tea which may be planted on virgin soil in extension of existing areas under tea is restricted under international law. Replacement of existing tea areas by planting on virgin soil is also restricted. There is no restriction, however, on uprooting and replanting of existing areas of tea, other than the cost of doing so. Extension of the acreage under tea may not be practicable; many gardens have not the land to do this and some may not wish to increase their acreage under tea for economic reasons which need not be considered here.

The economic life of a tea bush is from 40 to 50 years, and most progressive gardens in North-East India replace existing tea at the rate of 2% to 3% per year, so that it would be some 40 to 50 years before all tea on the garden would be converted to hedge planting. (Hedge planting in North-East India did not begin, except on an experimental basis, until 1949-50.) Further, while many prototype machines exist, there is no satisfactory machine presently available.

We anticipate that orthodox planted tea will continue to be plucked, pruned and cultivated manually, while the very *gradually* increasing area of hedge-planted tea will be plucked, pruned, cultivated, sprayed, etc., by machine, when such machines become available. Much of the labour thus released will be required for other tasks, which must now be somewhat neglected in the peak plucking season. For instance, cultivation of young tea has frequently to be postponed in August to October as all labour is employed in plucking, with a consequent retardation of the growth of the young plants due to weed competition.

Even were *all* plucking to be done mechanically, a situation we do not envisage for many years to come, labour would still be required for a great many tasks which it would be virtually impossible to mechanise completely. A good example of such a task is the selective removal, whether by hand or by knife, of weak and twiggy growth left in the pruning table following the level cut across prune which is carried out annually in North-East India. It is difficult to envisage such a task being carried out satisfactorily and economically by any form of machine.

Conclusion

Before any serious reduction in labour requirement on tea gardens could arise much time will elapse in which labour can be diverted gradually to other vital tasks, such as agriculture and food production, and with careful planning unemployment will not be a problem consequent upon mechanisation.

Photos: Tocklai Experimental Station.

A Note on the Mechanisation of Tea Cultivation in Ceylon

J. LAMB, MSc., F.R.I.C., A.I.C.T.A.
Director, Tea Research Institute of Ceylon

The mechanisation of tea cultivation and harvesting is attracting attention in many tea growing countries. In Ceylon, Mr. S. J. Wright recently visited the Dominion to report on the possibilities, and the main conclusions are summarised below.

AT least 50% of the cost of producing a pound of tea under present conditions in Ceylon is accounted for by labour costs and over 30% of these are charged to plucking. The need for investigating methods of increasing the output per labourer is obvious and with this in mind an application was made for Colombo Plan Assistance in 1952. Early in 1953 Mr. S. J. Wright, the well-known authority on agricultural engineering, was sent out to report on the possibilities of mechanising tea cultivation in Ceylon. What follows is largely based on his report.

The population of Ceylon is already high and is still rising, and from the strictly agricultural point of view it can only be presumed that the pace of mechanisation will have to be set by the pace at which numerous and highly complicated social problems are solved.

Basic considerations

The general urge towards higher wages and better living conditions has brought about a sharp, and still continuing, rise in the cost of producing tea. On the other hand, in the main consuming countries—where the curve of rising wage rates is almost certainly nearer its peak—the price of tea is rising to a point at which, what has hitherto been every man's beverage, may become a luxury. If mechanisation is to be worth while, therefore, it must aim at making it possible for tea to be produced with a substantially lower labour requirement.

Ceylon tea uses more labour than any other large-scale crop. The number of workers on a tea estate is at least 20 times as great as on a United Kingdom farm of the same size growing crops like sugar beet or potatoes, yet the value of production per acre is not much greater. But the lower labour requirement of Western farming is not so much the result of mechanisation in its modern sense of tractors and combine-harvesters, as of earlier developments like the reaping machine in the early 19th century. In most Western farming it is more than 100 years since primary crops like grain or hay were harvested mechanically, and far longer since any general cultivation was done by hand. By contrast everything in a field of tea is still done either literally by hand or with hand-wielded tools. A tentative analysis of the labour used on five estates puts the problem into perspective (Table 1).

Needs and limitations

If the rising labour costs are to be countered, the mechanisation of plucking and weeding must clearly be attempted. Any success in this direction could be expected to lead to a relatively simple extension to dusting or spraying, manuring and perhaps even pruning.

Owing to the nature of the terrain, the mechanisation of field operations in some tea growing areas is quite impossible. Wright came to the conclusion, however, that, at a very rough estimate, something of the order of 50% of tea land might conceivably be worked by mechanical implements. His general conclusion was, 'With Ceylon tea as it is planted and organised at present, there is little prospect of lowering production costs by mechanisation. But given the more appropriate bush pattern that could be introduced wherever tea is replanted, or new tea

TABLE 1
ANALYSIS OF LABOUR USE ON FIVE ESTATES

	Labour Days as % of Total	*Labour Days per acre*	*Labour Costs cents/lb.*
Plucking	44.4	127.6	32.8
Weeding	18.7	53.7	13.7
Forking and manuring	4.3	12.3	3.2
Dusting and spraying	3.6	10.3	2.6
Bush sanitation	3.1	8.9	2.3
Green manure	2.4	6.9	1.8
Pruning	1.9	5.5	1.4
Maintenance	6.4	18.3	4.7
(Total for field work)	(84.8)	(243.3)	(62.5)
Factory	8.5	24.4	6.3
Services	6.7	19.3	5.0
GRAND TOTAL	100.0	287.0	73.8

S. J. Wright examining a 5 ft. by 1½ ft. contour planted area of tea during his visit to Ceylon under the Colombo Plan

opened, there is every prospect that, by fairly straightforward mechanisation, the present labour requirement of tea growing could be reduced by at least 50%. In the writer's considered view, therefore, there is a very strong case for giving serious attention to mechanisation in direct association with replanting, and for instituting the further enquiry and experimentation necessary to bring it to practical fruition.'

Mechanisation and replanting

Mechanisation of tea cultivation is therefore linked with another long-term consideration—that of replanting with improved materials. G. B. Portsmouth writing in this number of WORLD CROPS indicates considerable possibilities inherent in replanting with clonal materials and if the hope of doubled or trebled yields is realised, the restriction of mechanised cultivation to half the existing acreage would not be such a disadvantage as might appear at first sight. A note of urgency is, however, introduced by the fact that replanting on the present pattern would prohibit mechanisation in that area for another 50 years. Practical work on the development of suitable methods of mechanising cultural operations should therefore be commenced without further delay.

Progress to date

Mechanical aids for uprooting old tea and for the preparation of land for replanting should not be unduly difficult and, in fact, some progress has already been made in this direction. It is of interest to record that Wright measured pulls of over 8,000 lb. in uprooting quite ordinary looking tea bushes. Some preliminary thought has also been given to the layout and spacing of tea bushes destined to be tended by mechanical means. Recent developments indicate that mechanical plucking and cultivation of tea are not by any means mere pipe dreams, for mechanical plucking by means of self-contained units driven by small high speed two-stroke engines carried in suitable harness on labourer's backs has recently been tested on a 50-acre scale by B. D. Fay, a Ceylon planter. The preliminary report which will appear shortly in *The Tea Quarterly* claims a considerable saving in labour with satisfactory sale prices for the products after manufacture. Further, an article by P. Skorin on 'The Mechanisation of Labour on Tea Plantations' published in *The Assam Review and Tea News* for October 1953 is illustrated by a photograph showing a heavy self-propelling machine described as the Kereselidze tea plucking machine working on a plantation in Georgia. Another photograph shows cultivators at work on the plantations of the Laituri tea growing state farm, Makhoradze District, Georgian Soviet Socialist Republic.

A tea-picking machine on a plantation in Soviet Georgia

Using the Tarpen Cropper (the machine used by B. D. Fay) and a very simple experimental manufacturing process called the P.F. (pulping and fermenting) process devised by the Tea Research Institute of Ceylon some years ago, it is possible, within two hours of mechanical harvesting, to prepare an admittedly very rough looking product which nevertheless yields a strong, pungent coloured liquor. Such a product, mainly on account of its appearance, is not at present acceptable to the tea trade, but it is possible that in order to reduce cost of production and maintain the popularity of tea as a beverage, some change in the traditional appearance of tea as retailed may have to be accepted.

Photos: p. 193, Tea Research Institute of Ceylon. p. 194, Planet News.

New Agricultural Films

Three new films for agriculture were shown recently in London.

Plant protection films

The first two films—'Spraying Progress' and 'Killing Weeds'—were made by Plant Protection Ltd. 'Spraying Progress,' which is in colour and has a running time of 30 minutes, is designed to show how the use of the low-volume sprayer for applying selective weedkillers can be greatly extended. The film shows how the low-volume sprayer tackles flea beetle, clover seed weevil, pollen beetle, pea aphid, Colorado bettle and mangold fly, potato blight and potato haulm.

'Killing Weeds' is a three-reel film, also in colour. The first part deals with the need to suppress weeds and shows the value of 'Agroxone' 4, Plant Protection's new hormone selective weedkiller. The second reel deals with the special problem of killing weeds in cereals and shows 15 of the most common weeds at the best stage for treatment. The third reel emphasises the need for improving grassland and thus increasing the available grazing and producing better quality silage, hay and dried grass. There is a certain amount of overlap in the material in the three sections of this film as they have been designed to be shown separately if needed.

Dorman Sprayer film

The third film is entitled 'Modern Crop Sprayers' and has been made for the Dorman Sprayer Co. Ltd. It is intended not only to act as a guide to field spraying machines but also to explain the necessity for so many different crop sprayer designs and sizes. The first point made by the film is that whatever the size of the farm, weeds and insect pests must be kept at bay, and for this reason it is essential to employ a crop sprayer. When choosing machines the farmer is advised to compare tank capacities, boom widths, height adjustments, and to see if there are any design improvements.

The performance of the entire range of Dorman crop sprayers is indicated by concentrating on 14 of the models made and some of these are shown at work in such a way as to emphasise the correct use of each type and size of machine. The basic design of the entire range is explained and typical examples of design improvements are given. The film runs for 17 minutes and has a commentary by Mr. F. Coleman, sales manager of the Dorman company. The technical direction and script of the film were by Mr. J. M. Beskine, who will be known to readers as a contributor to this journal.

Tea Research in Southern India

PETER DE JONG, B.A. (Hons.) Oxon.

Chief Scientific Officer, United Planters' Association of Southern India

Although it is smaller in size than the great industries of northern India and Ceylon, tea growing in Southern India is an important industry. It has made provision for the conduct of research which has had valuable results. The following account of the position in this regard has been contributed by Mr. Peter de Jong, Chief Scientific Officer to the United Planters' Association of Southern India.

THE realisation that there are more than 166,000 acres of tea in cultivation in the Southern Indian States of Mysore, Coorg, Madras and Travancore-Cochin often occasions surprise, and it is not widely appreciated that the South plays such an important part in the general pattern of the Indian tea industry. In fact, the Southern Indian section of the tea industry accounts for some 21% of the total planted tea acreage in divided India and produces approximately 19% of the total crop.

Location of the industry

The major tea-producing areas in Southern India are located at elevations ranging from sea-level to over 8,000 ft. on the slopes and central plateaux of the Western Ghats, the mountain feature which constitutes the 'backbone' of the Southern Indian Peninsula. The soils in this area are highly weathered soils of gneissic origin, classified as lateritic red and yellow loams. Depending upon local topography, the tea areas along these slopes are subjected to either one or both of the south-west and north-east monsoons, and rainfalls may range from under 40 to about 300 in. per annum. It can readily be appreciated that, under these widely varying conditions, methods of cultivation of the tea itself will be equally diverse.

The pattern of cultivation

While the general pattern of cultivation remains the same in each of the major planting districts, major differences are to be observed in such matters as the length of the pruning cycle and the type of pruning, which depend mainly on elevation above sea-level; type of shade tree employed and methods of shade management and, of course, pest and disease control measures. In many cases the age of the tea bushes varies considerably and, dependent upon the year of planting, the general make-up of the plant population also varies, the earlier planted tea being of more mixed type with a very marked China influence, while the more recent plantings consist predominantly of Assam types of tea.

Research provision

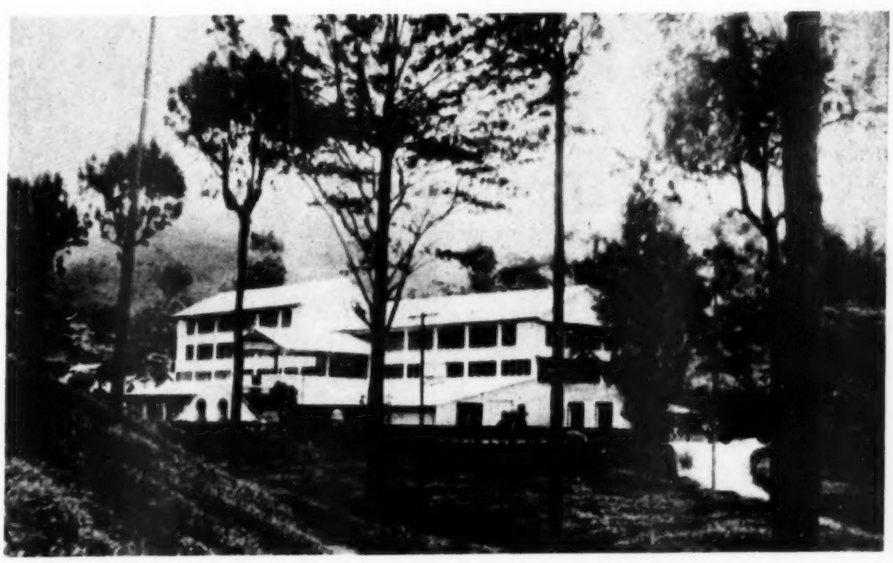
The Southern Indian plantation industry had long realised the importance of scientific investigations into the correct methods of crop management, but it was not until 1926 that the United Planters' Association of Southern India set up a scientific department to investigate problems associated with the cultivation and manufacture of tea. A field station and laboratory were established at Devarshola in the Nilgiri-Wynaad planting district of that name and adjacent to the Nilgiri Hills planting district, famous for its top quality high-grown teas. Between 1926 and 1931 the field station was planted up and the laboratory and staff accommodation built, equipped and put into operation. By 1931 the department had already begun to pass on to the planters much valuable advice on crop management.

Primarily, the scientific department functions as an advisory service, but to achieve this efficiently a certain amount of field research and laboratory investigation must be undertaken. Before 1939 considerable time was spent in investigating the chemical composition of the tea leaf. Field experiments designed to provide information on various aspects of manuring and crop management were laid out, and field investigations into the control of the tea mosquito (*Helopeltis spp.*), a serious pest in Central and South Travancore, were also undertaken.

The development of the department was to some extent interrupted by the war in S.E. Asia, but throughout this period investigations were maintained and by 1945 the department was fully prepared to go ahead as soon as conditions returned to normal.

DDT and mosquito blight

In 1946 samples of DDT became available for experimental use and the insecticide was tried out against the tea mosquito. It proved a most efficient material for the control of this insect, which feeds on the sap of the young leaf and stem tissue of the tea bush. The department gave considerable attention to the development of field control measures and as a result of field work by the entomological section, led by Mr. Ananda Rau, a technique for the field application of DDT in dust form was worked out, and in consequence the position in Travancore im-



Tea factory in the Nilgiris, South India

proved appreciably. A 5% DDT dust was formulated for use on estates using local China clay as a filler, and this was applied in two rounds of dusting in April-May at 20 lb. per acre. This, together with a further round of dusting in September succeeded within two years in so reducing the insect population that when, in 1952, *Helopeltis* was required for a field investigation it was only with great difficulty that it could be found in sufficient numbers. Before 1946 much of the tea in Central and South Travancore had been regularly attacked by the tea mosquito and production was kept at a very low level while capital deterioration of the estates was a very real problem. Since 1946 increases in yield of the order of 200 lb. of made tea per acre annually can be ascribed to the control of *Helopeltis*, while the healthy appearance of the tea testifies to the excellent effect the control measures are having on the capital value of the plantings.

Blister blight disease

About this time, however, the Southern Indian tea industry faced its major crop protection crisis. Widespread pest and disease problems had hitherto been unknown, even *Helopeltis* affected only some 30,000 acres, and fungus diseases of root, stem and leaf were of only local significance and of little economic importance. In 1946, however, the blister blight disease of tea, a leaf disease caused by the fungus *Exobasidium vexans*, appeared in Central Travancore and aided by environmental conditions ideal for the development of the fungus, spread rapidly throughout Southern India and thence to Ceylon. Within a remarkably short space of time there was no district from which the disease had not been reported, and considerable damage to the tea as well as major losses of crop occurred, as a result of fungus attacks which were concentrated on the tender leaf and stem tissue of the bushes, those parts of the plant which are harvested for manufacture.

This disease was well known in N.E. India where it had first been reported in 1858, but under the conditions of environment prevailing in those districts the disease had never been of more than sporadic importance. In Southern India, however, and also in Ceylon, the growth habit of the tea and the general conditions of climate proved ideal for the development and spread of the fungus, and in 1948 it was variously estimated that crop losses of the order of 20% to 25% of the total South Indian production were being caused as a direct result of attacks by this disease.

Tea receiving full NPK application, at U.P.A.S.I. Experimental Station

Pruning methods

Within a short time it was possible to suggest modifications of current agricultural practice which reduced the severity of fungus attacks, especially on tea recovering from pruning, which is particularly susceptible to attack. By altering times of pruning and reducing the severity of the cut so that the main period of regrowth occurred rapidly and during the dry period of the year when danger from fungus attack is at the minimum, it was possible to reduce the worst effects of the disease, which by its attacks upon the pruned tea prevented the bushes from establishing a satisfactory canopy of maintainer leaf.

Spraying and dusting

In many cases, however, alteration of pruning times and the extension of the pruning cycles did not provide the whole answer, and there were disadvantages resulting from the changeover to 'dry-weather' pruning, such as sun-scorch leading to branch-canker and other problems associated with drought and dessication. Investigations based on earlier work in N.E. India showed that efficient protection could be given to tea recovering from pruning, and also to seedling plants in nurseries, by applications of copper fungicides in spray or dust form, and techniques for spraying and dusting tea recovering from pruning were developed. Perhaps the most important modification was the introduction of low-volume application and the reduction of spraying requirements from over 100 gallons of spray liquid to less than 20 gallons per acre.

Shade management

The problem of protecting the tender leaves and shoots of tea in plucking still remained, and for some time it was believed that apart from a regulated policy of shade management and the introduction of slope pruning and plucking, little or nothing could be done to reduce the impact of the disease.

Shade management implied the reduction of stands of shade trees in badly affected areas and danger pockets to permit greater air circulation and allow more sun to reach the tea bushes, thereby creating an environment less favourable to the fungus. Regular lopping of shade trees, too, was undertaken before the outset of the monsoons, at which periods the

Contour planted tea in South India

Dusting tea to control blister blight

most severe attacks of the disease can be expected. This temporary reduction in shade canopy helps materially to combat the fungus.

The crux of the problem of blister blight control

In blister blight control the problem is essentially one of protecting a crop in which disease-susceptible tissue is constantly being produced, while the intervals between control treatments have to be adjusted to fit in with the plucking rounds in order to prevent any excess quantities of fungicide appearing on the harvested leaf. The only difficulty in Southern India lay in application. A method had to be found for treating large acreages of tea at regular intervals ranging from 8 to 12 days, depending on the duration of the plucking round. Some experience of large-scale applications of dust, using power equipment, had already been gained in the fight against *Helopeltis*, and it was decided to apply the lessons learned in this field to the problems of protecting tea in plucking against blister blight disease. Initial trials were started to investigate the effect of a range of copper dusts on the quality of the manufactured tea, freedom from taint and a high cup quality being, of course, of the greatest importance to the industry. By early 1950 it had been established that copper dusts could be applied to tea in plucking without creating any problems of taint or toxic hazard and without any detrimental effect on quality. At the same time preliminary trials showed that a certain range of copper dusts appeared most promising for the control of the blister blight fungus. Throughout 1950 and 1951 trials were carried out and in 1951 a series of large-scale trials were undertaken which showed conclusively that treatment of tea with dust formulations containing 2% metallic copper and using power-operated equipment which could be carried through the fields on the shoulders of a few men, gave a high measure of disease control. During trials in the Nilgiri-Wynaad district, increases of over 140 lb. of made tea per acre were recorded as a direct result of crop dusting. Later experience showed that for consistently effective control a 4% copper dust applied at rates varying from 6 to 10 lb. per acre was required, while to protect tea in the early stages of recovery from pruning a 6% copper dust applied by means of hand-operated rotary dusters appeared to be the most suitable technique.

Power dusting

Under favourable conditions power dusting allows some 80 acres of tea to be treated in a working day with a labour requirement of about eight men per machine. Where hand dusters are in use each operator can efficiently cover about 6 acres in a working day. Examination of a large number of costings of this type of operation disclosed that labour charges represented only about 8% of the total cost, the main charge being for material, owing to the relatively high cost of dust formulations. This is in direct contrast to hand spraying using pressure retaining knapsack sprayers operated on a battery system, where the output per man is only about 1½ acres per day. In this case the cost of materials, 50% wettable copper fungicides, is so low that in spite of high labour requirements knapsack spraying is at present more economical than dusting.

While investigations were proceeding into the possibility of large-scale power dusting the techniques of hand and power spraying were also being investigated. By 1953 many estates had returned to the original pattern of monsoon pruning, relying on either dusts or sprays to protect their tea, and many of the fields in the first and second years of the pruning cycle also were being sprayed or dusted.

Lightweight mist blowers

At present interest is focused on the possibility of introducing some form of portable lightweight mist blower or atomiser which will enable a man to treat some 20 acres of tea daily with a low-volume highly concentrated fungicidal emulsion, thereby further reducing application costs and administrative and organisational requirements. The control of this disease at present contributes largely to the cost of tea production in Southern India, and it is important to seek for even more efficient and economical materials to employ in the fight against blister blight and to this end new materials are constantly being examined and tested to assess their suitability against the fungus.

Mites on tea

Since 1949 there is some indication that another problem has slowly been developing in Southern India. Red spider mite (*Metatetranychus bioculatus*) and purple mite (*Eriophyes australasis*) have long been noted on tea in Southern India and have been regarded as minor pests of little economic importance. These mites are to be found on tea in most districts and their major infestation occurs during the hot dry months in the early part of the year. Except in a few isolated cases their presence has never been of any real significance and they have usually disappeared with the onset of the south-western monsoon rains. In recent years, however, it appears that they are becoming more numerous and more widely dispersed. There is some reason to believe that this is due not only to the reduction of shade tree cover creating a more favourable environment for them, but also, in part, to the widespread use of copper fungicides. It has been suggested that the use of certain fungicides, including copper, has a marked effect on the build up of spider mites, and this is borne out by experience in the citrus-growing areas of Florida and California. In certain areas of Southern India, also, there are indications that increases in mite infestations are positively correlated with applications of copper fungicides. This problem is at present receiving attention and a number

of promising acaricides are being tested. The solution is not simple, for it is a prime requirement that any agricultural chemical for use on tea must not possess undesirable qualities which may give rise to any taints or toxic hazard and this is emphasised in Southern India where the plucking of tea goes on throughout the year. All acaricides so far examined appear to possess undesirable tainting qualities, but it is hoped that among chemicals which appear to be actively acaricidal and whose properties regarding taint still require to be positively determined, there may be some which will assist the tea planter in his fight against the mites.

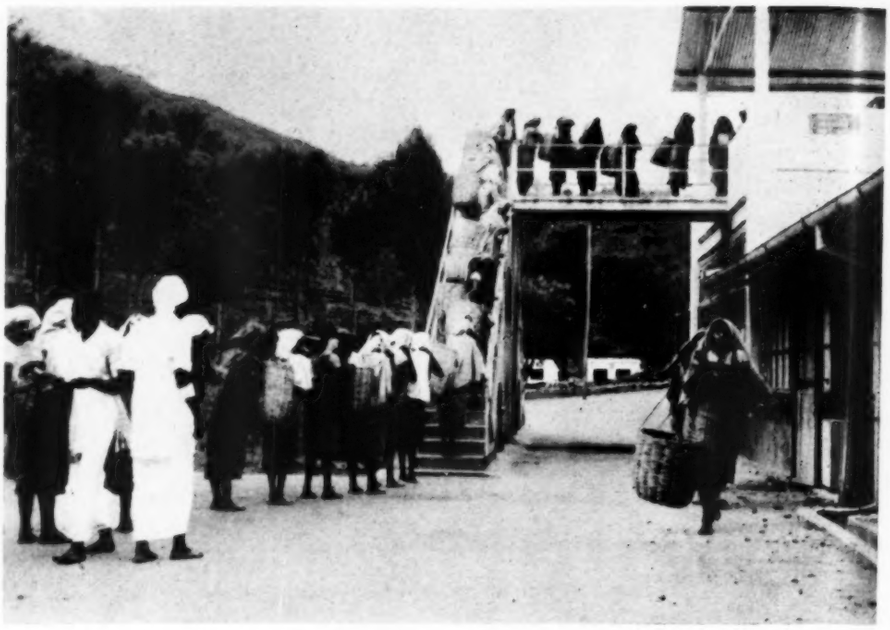
Manuring tea

Although much of the attention of the Scientific Department has been directed towards problems of pest and disease control problems which relate to the cultivation and management of tea have not been neglected. A comprehensive manurial experiment was laid down in 1940 to investigate the response of tea to varying levels of application of nitrogen, phosphorus and potassium, and by 1952 had completed four three-year pruning cycles. This experiment has given much valuable information, particularly about the need for adequate potassium manuring especially in areas where lack of water is likely to be a limiting factor. The results of this experiment suggest that in areas of Southern India where at certain times of the year water is a limiting factor, and this applies to most districts, stands of tea will decline if potassium is withheld and, more important still, additions of nitrogenous fertilisers alone may hasten this decline. In cases where properly adjusted mixtures of nitrogen and potassium are applied the benefits of manuring are likely to be considerable. The phosphorus requirements of tea appear to be adequately served by the soil itself and throughout the whole of this particular experiment no indication of response to phosphorus has been noted. This aspect will continue to be investigated and in 1952 and 1953 new experiments were laid out to provide more detailed information on the potassium requirements of tea and the complex interrelationship of nitrogen and potassium in tea nutrition.

Other investigations

From time to time miscellaneous investigations have also been undertaken regarding such problems as the effects of seed dressings on the germination of tea seed, the control of minor pests and diseases of tea and of shade trees, the selection and vegetative propagation of tea and similar questions. For the future a problem of major importance which requires consideration is the control of grass weeds in tea where, under certain circumstances, simple and cheap methods of chemical control would be most valuable to the industry. Attention has already been given to this problem, and there are indications that in some cases control can be achieved, though at present at rather excessive cost.

Many problems, both of major and minor importance, still remain to be investigated and time will doubtless produce the solution of some and the creation of others, providing a continual challenge to scientific investigations within the tea industry in Southern India.



Pluckers carrying green leaf to the factory

Massey-Harris-Ferguson Reorganisation

A big step forward is announced in the integration of the Massey-Harris and Ferguson organisations in the Eastern Hemisphere under the parent company, Massey-Harris-Ferguson Ltd., of Toronto, Canada. Grouped under the overall supervision of the executive committee of the Eastern Hemisphere Division are four main subsidiary companies, with headquarters in the United Kingdom. These are: Massey-Harris - Ferguson (Engineering) Ltd., Massey - Harris - Ferguson (Sales) Ltd., Massey-Harris-Ferguson (Export) Ltd., and Massey-Harris-Ferguson (Manufacturing) Ltd.

The chairman of the executive committee is Mr. J. S. Duncan, president of Massey-Harris-Ferguson Ltd., and Mr. E. W. Young, formerly sales director of Harry Ferguson Ltd., and now a vice-president of Massey-Harris-Ferguson Ltd., and managing director of its Eastern Hemisphere Division, is deputy chairman. In addition to Mr. W. W. Mawhinney, Mr. Lionel Harper, Mr. W. B. Wedd and Mr. J. W. Beith, who represent the subsidiary companies on the committee, there are four members with a more general responsibility. They are: Mr. G. T. M. Bevan, a vice-president of the parent company and director of Massey-Harris engineering in the Eastern Hemisphere, Mr. L. G. Reid, director of Ferguson engineering policy in the Eastern Hemisphere, Mr. H. W. Waite, comptroller responsible for financial planning and control and all legal and secretarial matters, and Mr. I. J. Wallace, director of supply and control, responsible for relating production and inventories throughout the Eastern Hemisphere to overall sales requirements and for general co-ordination of departmental activities. Secretary of the committee is Mr. H. A. R. Powell, assistant to the managing director.

Mr. Harry Ferguson, chairman of the parent company, is also chairman of the engineering company. This is concerned with the development of Ferguson products and has its headquarters at Coventry. Mr. J. M. Chambers, formerly chief engineer of Harry Ferguson Ltd., is chief engineer and a director of this new company.

The Improvement of Ceylon Tea

G. B. PORTSMOUTH, B.Sc., D.I.C.
Plant Physiologist, Tea Research Institute of Ceylon

Among the outstanding achievements of the tea industry of late years has been the introduction of vegetative propagation in replacement of propagation by seed, thereby enabling the existence of uniform plant populations, higher yields and increased resistance to disease. Progress in Ceylon in this regard is reviewed below.

THE economic life of a tea bush is a subject of much controversy. In Ceylon, at any rate, it would appear to vary inversely with elevation. On many low elevation estates the annual rate of resupplying, *i.e.* the replacement of dead bushes by new plants, may exceed 10% of the planted stand, which would indicate an economic life of under 20 years. On the other hand there are many estates, at higher elevations, which have fields planted more than 70 years ago and where the rate of resupplying is known to have been so low that a high proportion of the original bushes must still be in active production.

The fact that there are bushes over 70 years old which are still in bearing does not, however, imply that they are still yielding as well as when they were younger. A succession of comparatively severe top prunes every four or five years, and the constant damage to the root system occasioned by cultivation operations, must cause a continuing deterioration in yielding capacity. The existence of some limit to the economic life of the tea bush, wherever planted, must therefore be accepted even though it may not be possible to specify this limit in terms of years.

The need for replanting

Once the principle that there is an economic limit to the life of the tea bush is acknowledged then the necessity for all estates to maintain either a full resupplying programme or else adopt a system of periodic replanting becomes imperative.

Most of Ceylon's higher elevation tea is planted on land which once carried coffee. Complete disaster, however, overwhelmed the coffee plantations, during the seventies of last century, in consequence of the ravages of a leaf disease caused by the fungus *Hemileia vastatrix*. With coffee production no longer possible, those planters who succeeded in weathering the immediate financial crisis courageously set about replacing their dying coffee bushes with tea. Seed had to be procured as cheaply as possible from whatever sources were available and, although small quantities of Assam seed were smuggled out of India, most estates were planted up with seed of very mixed and often completely unknown origin.

This very mixed origin of much of Ceylon's older tea is reflected in the appearance of the fields today. Large-leaved Assam-type bushes can be seen growing next to small-leaved China types, while innumerable intermediate hybrid types abound. This difference in type between bush and bush is paralleled by as marked a difference in yield. Thus on a uniform area comprising 1,000 bushes of St. Coombs tea, Tubbs recording individual bush yields found a ten-fold range of variation in yield between bushes. A similar series of observations on another estate showed an even higher range of variation.

In view of these observations no doubt can remain regarding the scope for yield improvement which the replanting of such fields with uniformly high-yielding material has to offer.

Sources of planting material

Where is this high-yielding good-quality planting material to come from? India prohibits the export of all tea seed and the very mixed nature of Ceylon's own tea renders the production of better quality seed by breeding exceedingly difficult. Fortunately the very multiplicity of types to be found in our fields affords excellent scope for the selection of outstanding bushes which can then be developed into valuable clonal material by means of vegetative propagation.

Vegetatively propagated clones

Accordingly, following the pioneer work of Tubbs in 1937, which demonstrated the possibilities of propagation by means of single node cuttings, the Ceylon Institute has concentrated on the selection and development of high-yielding, high-quality, vegetatively-propagated clones. That this

Fig. 1.—Replanting with eelworm tolerant clones. The nursery and multiplication plots are situated on the eelworm infested area itself

TABLE 1

SOME SELECTED T.R.I. CLONES

Clone No.	Calculated Yields lb./acre				Manufacturing Quality	Rooting	Resistance to Blister Blight
	First Year	Second Year	Third Year	Yearly Average			
2,024	1,240	2,295	2,655	2,063	Above average	Very good	Very high
2,025	745	1,830	2,310	1,628	Average	Good	High
2,023	645	1,685	2,030	1,453	Above average	Very good	Average
2,021	810	1,500	1,800	1,370	Above average	Good	High
2,022	860	1,650	1,535	1,348	Above average	Good	Very high

policy has proved capable of producing first grade planting material in a very few years is demonstrated by Table 1, which gives the yields for their first three years of bearing of some of the Institute's better selections.

If these yields, which it may be noted have been obtained from young bushes between four to six years of age, are compared with the district average for 1952 of only 711 lb. per acre, it can easily be seen what immense possibilities replanting with such selected clonal material holds out for increasing estate yields. However a note of caution is necessary at this stage since these test yields are, of necessity, calculated from lines of only 30 bushes each, and until several acres of new clonal tea are actually in bearing it is not possible to say for certain if its full potentialities can be realised on an estate scale.

Criteria for selecting clones

All these clones, with the exception of 2,025, have produced made teas of above average quality when the leaf has been subjected to manufacturing tests. There is thus no reason to fear that Ceylon's famous quality will fall off in any way if properly selected clones form the basis of much of her future replanting policy.

Before passing any selection as suitable for multiplication on a large scale it is essential to know if the cuttings will root easily in the nursery and whether the root system subsequently developed is a suitable one. It will be seen from Table 1 that all the clones mentioned are satisfactory in this respect.

Disease resistance

The ease with which selection for resistance to diseases and pests can be carried out in the field is one of the most striking advantages of vegetative propagation. Following the advent of blister blight in 1946 it proved quite impossible to establish successfully new supplies of seedling origin in many of the worst affected districts. As a consequence the selection of clonal mother bushes possessing some degree of resistance to this serious leaf disease became of first importance. Now this procedure has become so much a matter of routine that all acceptable up-country clones are expected to display satisfactory resistance to blister blight. For many years past the Institute's comparative clonal yield tests have all been carried out without giving the bushes any blister blight protection. In view of this fact the superiority of the clonal yield figures given in Table 1 over the district average of 711 lb. per acre is even more pronounced, since this average was obtained from an area of tea which had been almost completely protected against blister blight by copper fungicides.

Selection for eelworm tolerance

The possibility of selection for eelworm tolerance, as demonstrated by Loos, is another important feature of vegetative propagation. The nematode concerned is the meadow eelworm (*Pratylenchus pratensis*), which in the past has rendered replanting or supplying almost impossible in some areas. Now, on at least one estate, a number of eelworm tolerant clones have been developed to a stage at which large scale replanting operations can be started. For success in this type of work both the nursery and the multiplication plots have to be established in a heavily infested area as can be seen in the photograph (Fig. 1) since it has been found that cuttings from apparently tolerant mother bushes cannot always be successfully established.

The technique of propagation

The technique of vegetative propagation, now that all initial difficulties have been overcome, is comparatively simple. The bushes selected for propagation are cut across at a level and the new primary shoots allowed to grow up unchecked until the stems start to turn red at the base and become woody. The shoots are now brought to the nursery where they are divided up into cuttings with a sharp knife, the soft apical portions and the hard woody basal portions of the shoot being discarded. The cuttings, which consist of a single node with its bud and subtending leaf together with the major part of the stem comprising the lower internodal portion, are then planted in prepared nursery beds and immediately shaded with fern or some other suitable covering.

It is most important that the cuttings should not dry out at any stage and the above operations are best carried out under shade. In preparing the nursery beds good soil texture and good drainage are the most important requirements. Furthermore no fertilisers must be added as otherwise root-

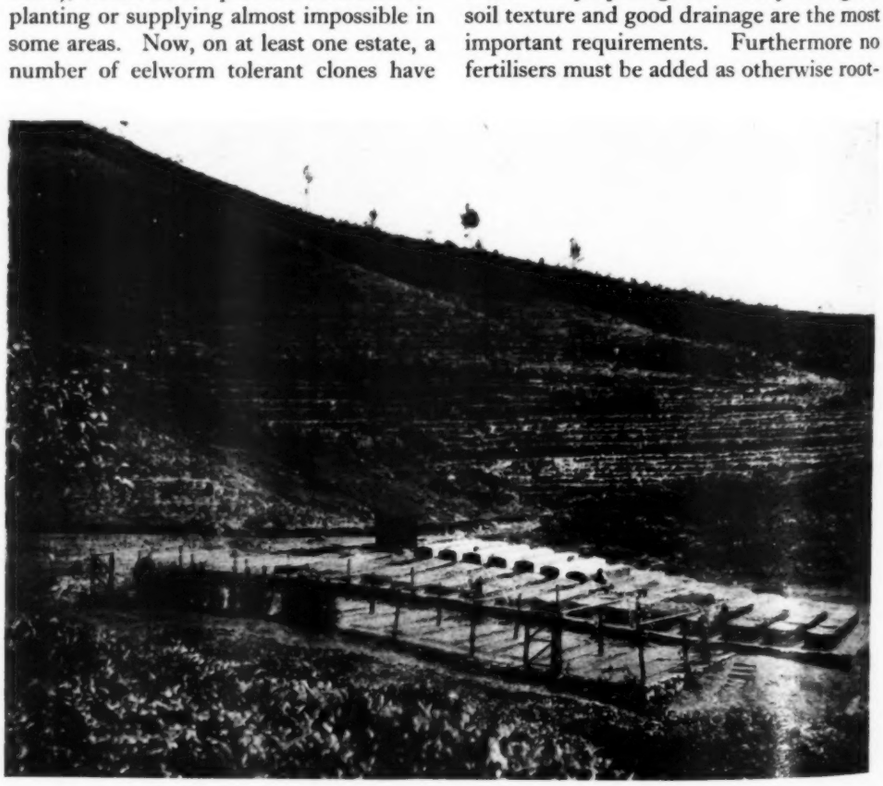


Fig. 2.—View of St. Coombs experimental nursery. Trials with new types of bed shading can be seen in progress in the foreground

Fig. 3.—St. Coombs Estate nursery for vegetative propagation laid out for circular pattern of spray irrigation

ing will be delayed. After about three months the cuttings should have rooted and the buds be starting to shoot. After about nine months the young plants should be ready for transfer to the field. Once rooting has occurred the shade must, of course, be gradually thinned out in order to harden off the young plants.

Nursery shade

The provision of adequate nursery shade presents quite a problem in itself when it is realised that with the present high planting stands of between 5,000 and 6,000 plants per acre, something like one acre of nursery bed space is required for each 10 acres of land being planted up. As long as nursery areas have been restricted it has proved possible to make use of the naturally occurring bracken fern (*Gleichena linearis*) for shade. This has considerable advantages since, if the fern is cut and used green, a gradual thinning out of the shade occurs as the fronds wither and dry out.

Unfortunately it is quite impossible to obtain adequate supplies of this fern when it comes to the setting up of the large nurseries covering several acres, which will be required if any large scale replanting operations are undertaken. Accordingly, recent work has been concentrated on finding some cheap and easily obtainable substitute for fern as a nursery shade. Some of these various experiments can be seen in the view of the St. Coombs experimental nurseries shown in Fig. 2.

At the present moment one of the most promising alternatives to fern shading would appear to be the use of a light iron framework covered with an open mesh woven coir fabric. The frames are made as standard half-hoop sections which are connected together along the length of the bed by a series of light round iron rods fitting loosely into slots on the tops of the hoops. The whole framework is thus light and easily movable while it can be extended to fit any length of nursery bed by the addition of extra half-hoops and connecting rods. It is, of course, practically indestructible and capable of being used over and over again. The woven coir fabric, which is a local product, can also be obtained in a number of different sized meshes, so that it is a relatively simple matter to reduce the amount of shade by substituting a more open weave. Given reasonable care this material should also last for a number of years.

Watering tea nurseries

Watering of a large nursery also presents something of a problem and, if carried out by hand, is not only unreliable but is wasteful of labour. Accordingly the installation of some type of modern overhead irrigation system appears to be highly desirable. Experiments in this connection are therefore also in progress and a rotating head system is installed in the old St. Coombs nursery (Fig. 3). However, this system, owing to its circular coverage, does not fit in too easily into the ordinary nursery layout and an oscillating line system will shortly be tried out in an experimental nursery.

Scope and possibilities of replanting

A well grown tea bush can yield, in two or three crops, something like a thousand cuttings per year. Once, therefore, a small multiplication area of each tested clone has been established it is a comparatively simple matter to produce enough good quality cutting material to plant up many acres. With the planting up of blocks of some of the better clones, totalling over two acres, in 1952 the Institute now has enough cutting material available to make an extensive replanting programme possible. As a consequence more than 10 acres of old tea on St. Coombs has already been uprooted and will be replanted with clonal material during the south-west monsoon period this year. Needless to say the cuttings have already been taken and the young plants are now well established in the nurseries.

Influence of soil structure and fertility

Much of the benefit of replanting with high-yielding, high-quality material may, however, be lost if the soil fertility of the area has previously deteriorated. In such a case determined efforts to improve soil fertility prior to replanting are advocated. The question of how best this should be done is still a matter of experiment. However, the temporary establishment of some quick growing grass crop would appear to present one of the best methods of rapidly restoring soil structure and improving fertility. It also has the advantage of breaking the permanent crop cycle, thus reducing the build up of any pest or disease organisms which might prove harmful to the tea.

Procedure at St. Coombs

Accordingly some of the experimental replanting areas on St. Coombs have been treated in the following manner. First the old bushes were winched out, thus effectively opening up the sub-soil. Then contour trenches measuring 18 in. by 18 in. were dug along the lines where the young tea plants would eventually be put out and the lines of Guatemala grass (*Tripsacum laxum*) planted in between. This grass, which is a very vigorous grower when manured, capable of giving up to 150 tons of green material per acre per annum, was then lopped at frequent intervals and the loppings put into the open trenches. After about 18 months the grass clumps were killed by cutting at ground level and the trenches filled in and levelled off. The

whole area was then covered with Guatemala grass loppings, taken from an adjoining area, and the trenches allowed to consolidate for approximately six months before the new tea plants were put out. A few months before the actual replanting, lines of some green manure plant, such as *Tephrosia vogelii*, were sown between the trenches to furnish shade for the young tea.

The whole improvement programme from the uprooting of the old bushes to the actual putting out of the new plants thus occupied about two years. The cost and the time lost in this procedure can naturally only be justified by results. However, selected clonal plants put out on land treated in this manner have been brought into bearing in less than two years. The whole time, from the original uprooting to the bringing of the area back into bearing, is thus only four years, which compares very favourably with the five or six years normally required for bringing seedling plants into bearing at the same elevation. It may, therefore, be safely concluded that the time saved by using rapid growing vigorous clonal material instead of seedlings for replanting is more than enough to permit of the introduction of a useful soil improvement programme, with its consequent break in the permanent crop cycle, without increasing the length of time the land is out of bearing.

Summary and conclusion

To sum up, the use of selected clonal material for replanting would appear to offer the following advantages over the unselected Ceylon seed currently available:

1. Much higher potential yields.
2. As good, if not better, quality in the made teas.
3. More rapid growth and hence a considerable reduction in the time required to bring a replanted area into bearing.
4. Resistance to diseases such as blister blight and tolerance to pests such as the meadow eelworm.
5. Complete uniformity among all the plants of any one clone.

Undoubtedly the present selected clones are still far from ideal but the process of selection is a continuous one and new and probably better clones are already under test. In any event the fact that high-yielding, high-quality clones have already been produced in sufficient quantity to permit of large scale replanting operations being undertaken less than 17 years from the start of the Institute's vegetative propagation programme is no small achievement.

Photos : Tea Research Institute of Ceylon

Australian Farming Notes

(From Our Australian Correspondent)

Victorian wheatgrowers' difficulties

Victorian wheatgrowers have urged the State Cabinet to fall into line with other states and enable a wheat stabilisation plan to be completed. The president of the Victorian Wheat and Woolgrowers' Association, Mr. G. H. Hunter, said: 'We appeal strongly to the Victorian Government to set aside whatever political objections it may have to the policy agreed upon by a majority of states. . . . Any further refusals by Victoria could prejudice the introduction of a plan altogether—or, at least, make any further proposals of such a character as to be of no use to the industry. In any case, the period for negotiation on a long-term stabilisation plan has now expired and growers expect the Victoria Government to approve the proposals and so end anxiety for the future.' Meanwhile, the Victorian Premier, Mr. Cain, has stated that wheatgrowers are 'lions led by political asses.' He said growers would 'have to keep their feet on the ground if they wished to protect their industry.' Mr. Cain said he was confident that Victoria's plan for stabilisation would be carried, if put to a poll of growers. This plan would give growers an assured price for the whole five-year stabilisation period, he said. Under the plan, a ballot of wheatgrowers would decide whether they prefer a five-year plan of wheat stabilisation at 14s. a bushel for home consumption—or whether they would prefer the first three years' price at 14s. a bushel and the price for the last two years based on the cost of production, with 14s. a bushel for stock feed.

Rice growing tests

Representatives of Northern Development Pty. Ltd. have announced that they propose to continue rice-growing tests along the Fitzroy River on Liveringa Station in the Kimberleys, Western Australia. They said that the company, which has its headquarters in Sydney, had spent 'a fair amount of money' on experimental growing. Unfortunately, drought conditions had been experienced during the past two years. However, the representatives were impressed with the possibility of developing rice in the area on a commercial basis.

Wheat record

An Australian wheat record is claimed for Mr. L. H. Lange, of Natimuk, Victoria, whose crop of Pinnacle won the Southern Wimmera wheat crop championship for 1953 with an average yield of 76.8 bushels an acre from 52.4 acres. The Victorian Minister for Agriculture, Mr. Stoneham, said that this phenomenal yield was obtained on land which had a long history of regular cropping on a fallow-wheat rotation and had only one year's spell under pasture in the past ten years.

Victoria's wheat crop this season will be at least 8 million bushels higher than experts expected. The total yield will be about 54 million bushels. With almost all the crop in, more than 49½ million bushels has poured into silos, bulkheads and bag storages. Growers will hold back about 4 million bushels for seed and feed. Earlier estimates had placed the harvest at between 40 and 45 million bushels. However, improved varieties of seed and favourable weather had led to the big harvest. It would have been much lower but for soaking rains in November, and weeks of warm, dry weather during harvesting. Western Australia's wheat crop is also expected to exceed the 1952-53 harvest by some 2,800,000 bushels. Following good finishing rains, the crop estimate has been raised from 37,000,000 to 38,300,000 bushels.

Production of Perkins Engines in France

A reception was held recently at the City of Peterborough Town Hall at which Mr. Frank Perkins, chairman and managing director of F. Perkins Ltd., Peterborough, announced arrangements for the production of Perkins 'P' series diesel engines in France. The reception was attended by many distinguished visitors from both France and England.

Under the arrangements, a new company is being formed which will include French interests of approximately 50% of its capital, and this company will be responsible for the manufacture of 'P' series diesel engines in France by an independent French industrial concern. The latter will be Ateliers G.S.P. which will assemble the engines from British-made parts in their factory at Courbevoie. They will then gradually introduce French-made parts, until eventually the engines will be wholly of French manufacture. The parts, whether French or British, will be completely interchangeable. Production is expected to be about 3,500 engines for the first 12 months, but after that initial production the figure should increase rapidly.

General view of a tea estate in the Usambara Mountains, Tanganyika

The Tea Industry of East Africa

T. EDEN, D.Sc., F.R.I.C.
Director, Tea Research Institute of East Africa

Tea as a crop is increasing in importance rapidly in East Africa. Recently the East African Tea Research Institute has been established at Kericho in Kenya. The following account of the conditions under which tea is grown has been compiled by Dr. T. Eden, Director of the Institute and formerly of the Tea Research Institute of Ceylon, who is well known as an authority on all aspects of tea growing and has previously contributed articles on various aspects of the tea crop to* WORLD CROPS.

THE tea industry has a well recognised place in the economy of East Africa even though its size is small in comparison with those of India and Ceylon. As an industry it is hardly more than a generation old, though records of the importation of plants and seed go back to the beginning of the century.

In 1900, plants were imported into Uganda and were established at the Botanic Gardens, Entebbe. At about the same time the Amani Research Station, then under German auspices, reared a number of specimen plants. In Kenya, the initiative was taken by a private individual, Mr. G. W. L. Caine, of Limuru, who imported a small quantity of Indian seed in 1903.

It was, however, much later before commercial development started on a scale leading to the foundation of a plantation industry proper. Between 1921 and 1925 three companies started operations in the Kericho and Limuru districts of Kenya and a beginning was made on a commercial scale at Tukuyu in Tanganyika. In Uganda tea production developed slowly from the original Entebbe plants, and from a consignment of seed imported in 1909, but no significant advance was made there till the early thirties.

By 1935, the first year for which the official figures of the International Tea Committee are available,[1] the acreages were Kenya 12,812, Tanganyika 3,343, Uganda 1,930. At this stage the tea industry may well be regarded as being definitely established.

Geographical distribution: soils and climate

The soils of East Africa show a wide range of types and properties due partly to their lithological origin and partly to their development in zones of markedly different rainfall and temperature. Those that are suitable for tea growing are all of a type described by Milne[2] as red earths derived from various parent rocks, including phonolite, granite, gneiss, sandstone and more recent deposits produced by volcanic activity. Some are described as laterite in the now obsolete sense of having clay fractions of low silica-sesquioxide ratio. All are free draining, are highly oxidised and have reaction values within the acknowledged range for tea (pH 4.5 to 6.2). They are generally found at the higher altitudes where rainfall is more abundant, as, for instance, on the escarpments of the Rift Valley in Kenya, in the Usambara Mountains and on the Mufindi escarpment in Tanganyika and the foothills of the Ruwenzori range in Uganda. The broad range of altitudes lies between 3,000 and 7,000 ft. above sea level.

The red earths develop under rainfalls as low as 40 to 50 in., which are marginal for tea cultivation. Consequently the extent and distribution of tea in East Africa is restricted less by soil characteristics than by the adequacy or otherwise of rainfall. The accompanying map shows how widely the chief centres of tea production are dispersed.

Besides having markedly different rainfalls, East African tea districts show, broadly speaking, two different types of annual distribution. The rainfall pattern is governed primarily by the apparent course of the sun across the inter-tropic zone. Superimposed on this pattern are local ones arising from such circumstances as altitude

*In some reports and statistical compilations Nyasaland is erroneously included in British East Africa which properly comprises Kenya, Tanganyika and Uganda only.

RAINFALL PATTERNS IN EAST AFRICAN TEA DISTRICTS
(Excess + or deficit – based on monthly averages)

Locality	*Latitude*	*Annual Rainfall in.*	*Distribution* J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Fort Portal ..	0.40°N.	60	–	–	–	+	+	–	–	+	+	+	+	–
Tukuyu ..	9.15°S.	97	+	+	+	+	–	–	–	–	–	–	–	+

and proximity to Lake Victoria. In the main, however, the districts near the equator, *i.e.* those of Kenya, Uganda and northern Tanganyika, have two rainfall peaks a year, as the sun crosses them at or near the equinoxes. The southern Tanganyika districts have only one peak and the rainy season is less prolonged. These localities have a six-month dry weather during which the monthly precipitation is below the monthly average, and absolute droughts are of regular occurrence. As examples of these distributions, the patterns for Fort Portal, Uganda, and Tukuyu, Tanganyika, are appended.

The average rainfalls in other districts are as follows:

	In.
Jinja-Kampala	40–65
Kericho	63–72
Limuru	52
Usambaras	50–80
Mufindi	45–65

These variations in total rainfall and distribution pattern lead to correspondingly wide variations in yield which may range from 200 to 1,500 lb. per acre, according to circumstances.

Cultural conditions

The East African plateau on which the tea districts are situated provides large areas of land of more gentle contours than in the old-established tea districts of Ceylon, South India and Darjeeling. The relatively new soils are more erodible than in these Asiatic districts, but preventive measures are more easily applied. In Kenya and Tanganyika mechanical terracing of the land and some contour planting provide adequate protection against soil erosion, and these soil conservation practices are general: in Uganda progress in this respect is not so evident. Cultural practice approximates to the Ceylon type with bushes permanently in bearing, except immediately after the recurrent pruning operations which are organised in periods of from two to five years according mainly to altitude.

The use of shade trees is not so prevalent as elsewhere, but is being extended. Green manuring either by periodic pollarding of shade trees or of bush green manures is virtually unknown. The latter system would, in any event, be hazardous in the drier areas because of competition between main crop and green crop.

The soils, being newer and more fertile than is usual in Asia, are not highly manured, and so far the recently inaugurated experiments of the Tea Research Institute show only a moderate response to added nutrients in specific localities.

Diseases, pests and weeds

The newness of the crop and its wide dispersion have an obvious bearing on the low incidence of tea diseases in East Africa, notwithstanding the monocultural system of cultivation. Hansford[3] in Uganda listed only six species of fungi attacking tea in his survey; The Wallaces' list for Tanganyika[4] extends to 13 species. No corresponding list has been published for Kenya. By way of contrast, Petch and Bisby[5] record 55 in Ceylon and Hainsworth 35 in Assam.[6]

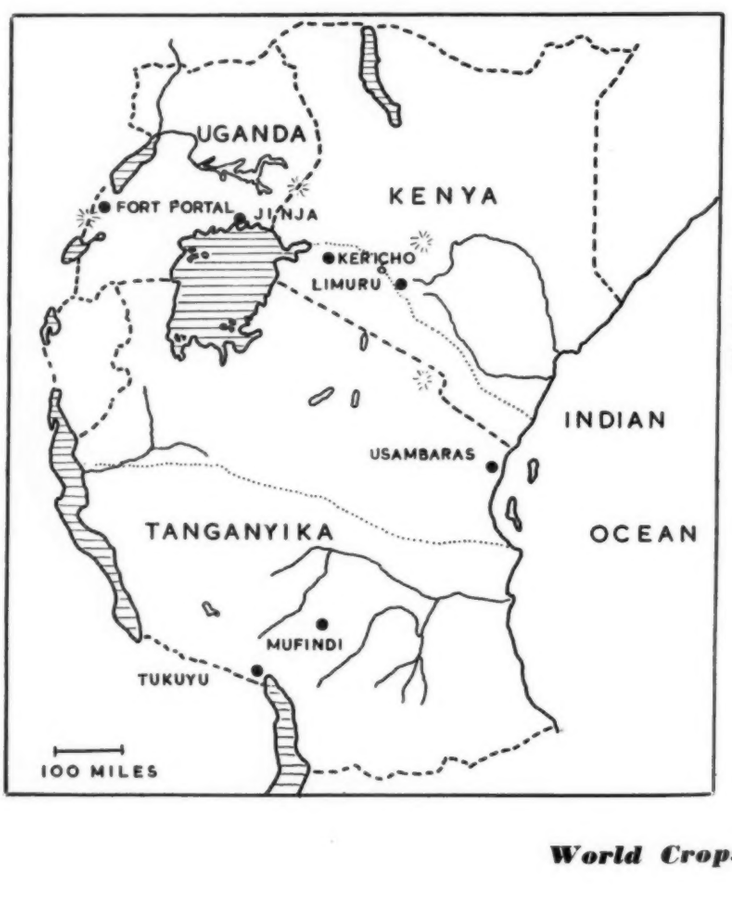
Only one fungus disease is of importance, the root-rot caused by *Armillaria mellea*. Insect pests are also noticeably mild, the major one being *Helopeltis* species. The incidence of this pest is very deceptive. Contrary to experience in South India, where acute defoliation occurs from mosquito bug attacks, leaf damage in East Africa is small, but a severe gnarled stem canker can develop, as reported by Leach and Smee from Nyasaland.[7]

The physiological sulphur deficiency disease, tea yellows, described in Nyasaland by Storey and Leach[8] is found in Southern Tanganyika, where it is thoroughly controlled by manurial applications of sulphate of ammonia.

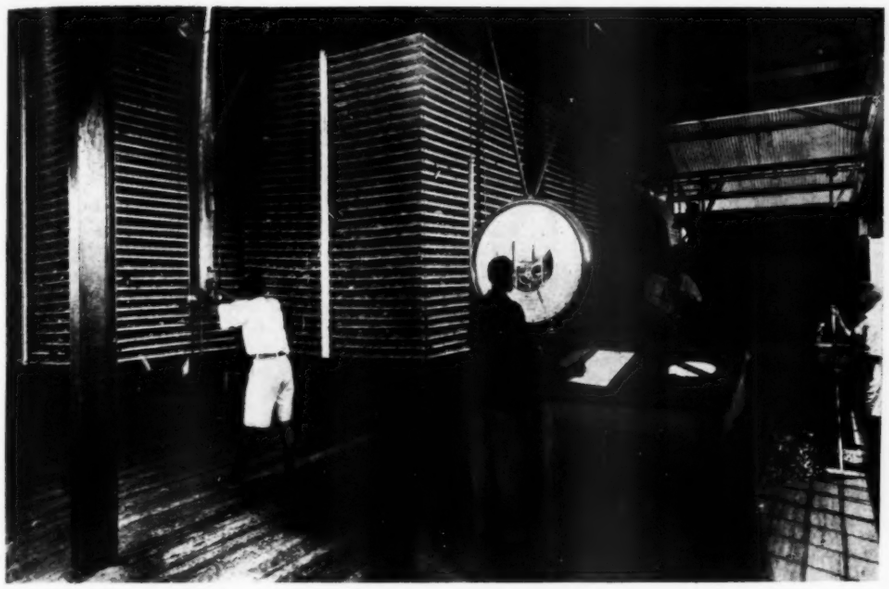
Weeds are as troublesome in East Africa as elsewhere, two of them particularly so. The couch grass *Digitaria scalarum* spreads rapidly in newly broken land if intensive clearing is not carried out immediately. Its effects on both young and mature tea are severely damaging and its removal when firmly established very costly. The species is widely distributed. In Southern Tanganyika the more prevalent scourge is lalang grass, *Imperata cylindrica*. No satisfactory weed-killer has yet been found to deal with these species, partly because those tried have an equally deleterious effect on tea, and partly because of the difficulties of application without contamination of the tea leaf.

Manufacture

Whilst the cultural systems in use are akin to those of South India and Ceylon, the manufacturing regime has much in



The chief tea districts of East Africa



Loading and weighing leaf on mobile withering tats

common with that used in Assam, particularly in the use of light withers. The withering process, being the first to which the leaf is subject, determines the scope of subsequent operations and the style of the resulting tea. African labour is less skilled than Asian and, since quality in tea is primarily dependent on skill in plucking, high standards are difficult to achieve. The localities with long dry periods conductive to slow growth are more successful in producing quality than those where growth is lush and evenly distributed throughout the year.

Factories are of many types, from small units of the simplest design and equipment to some of the most modern in existence. The mobile tat system of withering is now to be found in all three territories.

Organisation of the industry

Most of the tea acreage in East Africa is in the hands of limited liability companies and, in fact, about one-third of the total acreage is under the control of two companies. There are a number of small private growers who either confine their efforts to a small acreage or combine a modest acreage of tea with general farming. In either event they sell their leaf to other estates for manufacture. In Kenya there is a Government scheme for co-operative small holdings for Africans, but it is at present only in an embryonic stage.

The over-all organisation of the production side of the industry is in the hands of the territorial Tea Boards, one for each territory. These are statutory committees whose membership is divided between representatives of the industry and Government. The Boards license acreages for tea cultivation and control the quantity of tea scheduled for export, retaining enough within East Africa for local consumption. Of recent years, according to the magnitude of the crop, this domestic consumption has varied between 33% and 50% of the total production. Internal retail price is regulated by agreement with the territorial governments. The Boards are empowered to levy a cess on both acreage and production, and to apply its proceeds for the benefit of the industry as a whole. From this source the Tea Research Institute of East Africa receives its funds, which are administered by a governing body on which the Tea Boards, the territorial governments and the East African High Commission are represented.

In order to cater for the internal consumption needs of East Africa, the majority of producing companies are members of the Associated Tea Growers of East Africa, which maintains modern packing factories in Kericho, Kenya and Kampala, Uganda, for blending, packeting and distributing tea to the local retail market. These factories are capable of dealing with 15 million lb. of tea per annum.

Acreage and production

Originally East Africa was a signatory to the International Tea Agreement, which imposed restriction on both tea production and expansion of acreage. When the agreement was renewed in 1949 East Africa contracted out of the agreement and since the end of the war has been increasing its acreage by an average of 2,000 acres per annum.

The peak figure for East African production was 21,970,000 lb. in 1951, a year of very favourable rainfall. The last quarter of 1952 and the first of 1953 were exceptionally dry and the production in 1953 was the lowest since 1949, despite the increase in acreage. The following statistical summary depicts the extent of the industry at the close of 1953.

SUMMARY OF EAST AFRICAN ACREAGE AND PRODUCTION STATISTICS, 1953

Territories and Localities	*Acreage*	*Production lb.*
Kenya:		
Kericho	15,566	12,881,033
Sotik	1,462	
Nandi	2,805	
Limuru	1,800	
Other	78	
Total	21,711	
Tanganyika:		
Usambaras	3,140	2,838,583
Mufindi	4,630	
Tukuyu	2,730	
Total	10,500	
Uganda:		
Buganda	5,313	4,793,927
Fort Portal	2,485	
Total	7,798	
Total	40,009	20,513,543

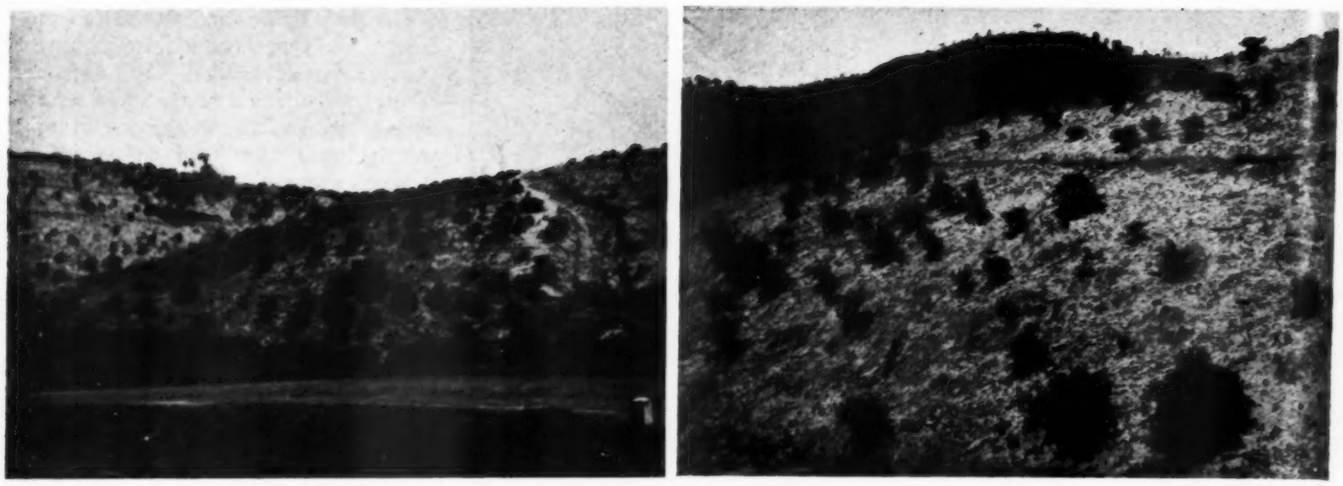
The evaluation of the industry's turnover is complicated by the division between internal and external trade. In 1952 the Kenya tea exports ranked fifth in value and comprised 5.1% of total exports. The corresponding values for the other territories were Tanganyika 0.6, Uganda 0.6.[9]

REFERENCES

1. International Tea Committee: 'Bulletin of Statistics,' 1953.'
2. G. Milne: 'A Provisional Soil Map of East Africa, 1936. (Crown Agents for the Colonies, London.)
3. C. G. Hansford: 'Annotated Host List of Uganda Parasitic Fungi and Plant Disease.'
4. G. B. and M. M. Wallace: 'List of Plant Diseases of Economic Importance in Tanganyika,' Commonwealth Mycological Institute Paper 26.
5. T. Petch and G. R. Bisby: 'The Fungi of Ceylon,' 1950. *Peradeniya Manual VI* (Ceylon Government Press).
6. E. Hainsworth: 'Tea Pests and Diseases and their Control,' 1952. (Heffer, Cambridge.)
7. R. Leach and C. Smee: 'Gnarled Stem Canker of Tea,' 1933. *Ann. Appl. Biol.*, **80**, 691.
8. H. H. Storey and R. Leach: *Ibid.*, 23.
9. *Quarterly Economic and Statistical Bulletin:* East African Statistical Dept., June 1953.

National Institute of Agricultural Engineering

It is announced that the National Institute of Agricultural Engineering will be opened for inspection by visitors from 10 a.m. to 5 p.m. on Wednesday and Thursday, May 26 and 27, 1954 when the various lines of research and activity of the Institute will be shown.



Extreme examples of poor small holdings. Although these must not be taken as average, there are many small holdings in this condition

Tea as a Crop for Small Holders in Ceylon

J. LAMB, M.Sc., F.R.I.C., A.I.C.T.A.

Director, Tea Research Institute of Ceylon

OF the total of approximately 570,000 acres of tea growing in Ceylon some 70,000 acres are owned by small holders. Tea has not, however, proved to be a particularly suitable crop for small holders in Ceylon, where far too many tea small holdings are in a state which disgraces even the generally low standard of peasant agriculture.

Low standard of peasant tea holdings

There are two main reasons for this state of affairs. First, the traditions of shifting cultivation still persist even in areas where comparatively dense populations have been settled for generations. In past ages when populations were sparse and land plentiful, the tapping of inherent fertility, followed by natural regeneration of temporarily exhausted soil, may have been quite a sound system of agriculture from a long-term point of view. Unless, however, natural controls of population are allowed to operate, such a system is not compatible with present-day conditions. The only possible alternative is the adoption of agricultural methods which conserve fertility such as those practised with success by the larger plantations.

In another article in this issue of WORLD CROPS details are given of the high level of manuring practised by tea estates and figures are quoted showing that all the nitrogen, phosphate and potash removed in plantation crops are replaced by applications of mineral fertilisers. In addition, well managed tea contributes large quantities of (leaf-fall) mulch to the soil, particularly after pruning, whilst shade trees, green manures or thatch all supplement this supply of bulk organic matter. The practice of mulching with Guatemala grass has been gaining favour in recent years and poor areas of tea may receive dressings up to 15 tons of green stuff per acre. The same article quotes figures showing that the organic matter in well-managed tea soils has actually tended to increase over the past 50 years.

The introduction of conservative methods of agriculture to small holders in the tropics appears to be one of the outstanding needs of the present time. Tea small holders are only a small part of a vast problem. An editorial comment in WORLD CROPS in January 1951 on ' The Small Holders in the Tropics ' covers the subject very adequately. ' In the pages of this journal many aspects of the problem have been considered from time to time; at the United Nations conference on the conservation of natural resources held at Lake Success last year a whole plenary session was devoted to the question, regrettably without the emergence of any clear-cut finding, while there is an increasing spate of published papers and reports on diverse aspects of the same great question. Meantime, " time marches on " inexorably and, despite local improvements, the problem as a whole becomes ever more and more urgent, reinforced and accelerated by political agitation born of growing discontent with things as they are.'

There is, therefore, no need to enlarge on the common failings of small holders with respect to the disastrous system of cropping soils to their exhaustion point, except to express the fear that land exhausted by perennial crops may take much longer to regenerate than land temporarily exhausted by a succession of annual crops. The fragmentation of estate land amongst peasants, which is so attractive from a short-term political viewpoint, far from helping to solve this problem, only increases its scope.

The second reason for the small holders' failure with tea is more specific. Harvesting of a tea crop involves the removal of foliage leaf at intervals of about a week and this is obviously fraught with many dangers. Unlike, say, coconuts, or cocoa, where the plant offers a harvest commensurate with its capacity to yield, and where nothing more than the harvest offered by the plant is taken, there is no limit to the amount of foliage which can be removed from a tea bush.

Maintaining foliage

Under good management the amount of maintenance foliage is carefully built up after pruning before the bushes are brought back into plucking. When the maintenance foliage is judged to be sufficient for plucking to commence, further growth is shared with the bush, for each new shoot is allowed to grow to the point where a full leaf will be left after two leaves and a bud have been removed for manufacture. The maintenance foliage is therefore continuously built up and

ample capacity maintained for assimilation of carbon dioxide from which the major part of the crop is synthesised. The uptake of nutrients from the soil will also depend on the maintenance of an adequate cover of foliage and it follows, therefore, that fertilisers will be largely wasted if bushes are overcropped.

An experiment laid down 14 years ago at the Tea Research Institute has demonstrated, in no uncertain manner, that careful plucking is of supreme importance. After an initially heavy yield of leaf of indifferent quality, severe plucking results in a steady deterioration in the condition of the bush, and at the end of a pruning cycle of three years the maintenance leaf and pruning wood on severely plucked bushes is under 30% of the amount on normally plucked bushes. In the following cycle, yields, despite severe plucking, fall to a very low level and the bushes are reduced to a struggle for existence. After three years of severe plucking, experimental plots restored to normal plucking continue to yield at a low level throughout the following cycle, and it is obvious that the damage done by continuous over-cropping is not easily corrected.

A vicious circle

It is very hard (even if it is possible) to convince small holders that lighter plucking will give greatly increased yields, especially as the benefits of lighter plucking take several years to accrue. In the meantime, response to fertilisers, even if the use of fertilisers can be encouraged, will be so poor as to make it uneconomic thus further roughening the road to improvement. To complete the vicious circle, the poorer the peasant the stronger the urge to grab any leaf produced by his bushes, and the degree of debilitation thus brought about exposes the soil to insolation and erosion with results too obvious and too depressing to enlarge upon.

The radical solution

The radical solution to this problem is to reafforest or grass down the exhausted holdings and to encourage or actually subsidise the planting of other badly-managed areas with crops requiring less skill in management. Above all, peasant agriculture should be restricted to the growing of crops which do not require continuous attention, for the average peasant will not apply himself to such tasks. Tea estates employ roughly one labourer per acre of tea on a six-day week, and the outturn of labour is well over 80%. A peasant with even one acre of tea must therefore do a full week's work to maintain his holding in good condition. Some Ceylon small holders with an acre of tea actually employ labour, especially for plucking, and this does not help to maintain either a high standard of living or a high standard of plucking.

Conclusion

The 70,000 acres of tea small holdings in Ceylon, therefore, present some formidable problems. Radical solutions of these problems do not at present appear to be financially or politically possible. To some extent education and propaganda will help the situation. The Tea Research Institute has an extension service which is of material help to those peasants who maintain their holdings in anything above a marginal condition. Even small improvements to the standard of plucking attained by education and propaganda will have marked effects upon yields and, so long as tea prices remain at high levels, substantial progress is possible. The better holdings may even be improved to a point where they will respond to fertilisers.

The Ceylon Government is now organising agricultural co-operative societies amongst tea small holders. The greatest field for co-operation is in the collective buying of leaf and organisation of manufacturing facilities. Properly run, co-operative organisations should be able to improve standards of plucking by rejecting coarse leaf and paying fair prices for good leaf. If good leaf fetches good prices, better plucking should result, in which case improved yields may reasonably be expected. Subsidised fertilisers, supplied through co-operative organisations to holdings carrying sufficient maintenance foliage to enable response, will undoubtedly have spectacular results, but there are grave dangers of too much faith in subsidised manure. The way is open to considerable achievements by co-operative organisations, provided managerial talent and integrity make such things possible.

Photos: Tea Research Institute of Ceylon.

Grow More Food Drive in Ceylon

In order to increase the production of food, particularly rice, the Ceylon Government is making efforts to mechanise food cultivation in large areas of land in the dry zone of the island. The Government propose to bring these areas under cultivation by tractors, 175 of which have been presented to the island by the Government of Australia.

The United Kingdom Government offered to provide, under the Colombo Plan Technical Co-operation Scheme, the services of a British engineer, on loan for one year, as manager of the tractor station. The expert selected for the appointment is Mr. John Dickins, who is mechanical superintendent, Sudan Public Works Department.

Further examples of poor small holdings

(*Left*) **Diverted water flowing into the secondary channel.** (*Right*) **Water is turned into a subsidiary channel between beds**

A Note on Irrigating a Tea Nursery

Readers may be interested in a novel and efficient method of irrigating a young tea nursery in South India.

The nursery is made on a gentle slope, with the beds running across the face of the slope. Water is gravitated across the top of the nursery from a distant stream by means of a channel. From this the water is diverted into a secondary channel running down the centre of the nursery. The water then runs off the secondary channel herring bone fashion, into subsidiary channels between the seedling beds. This is achived by damming the secondary channel opposite the beds to be watered and letting the water run between the beds, where it seeps down to the plant roots through holes made in the subsidiary channels, about 6 ft. apart.

It is claimed that young plants can go through hot weather without any shade over them. That this is possible may be seen from the third picture, showing healthy and vigorous 18-month-old plants which have been watered in this fashion, and which have never had any shade over them. The secondary channel may also be clearly seen in the picture.

By using this method a considerable saving of labour and of shading materials is effected, a fact which is certainly worthy of note in these days of rising costs.

Eighteen-month-old plants and secondary channels

MCPA Weedkiller

An entirely new principle is stated to be embodied in ' MCPA 90,' a selective weedkiller introduced by J. D. Campbell and Sons Ltd. This product is 90% pure MCPA, active weedkilling agent, in the form of a soluble powder. It is said that concentration is two and a half times as great as in the best potassium salts and over four times that of the sodium salt; and that it sets a new high standard in purity. ' MCPA 90 ' is offered in 12 oz. packs sufficient to treat 1 acre.

European Training Course in England

Thirty European experts took part in a training course on farm planning and budgeting services in farm management advisory work which was held in England from March 19 to April 3, 1954. The object of the course was to assist the European countries to improve their agricultural advisory services in farm management work, particularly in relation to farm management and farm budgeting, as part of the drive for greater productivity in European agriculture. The course was under the technical direction of the University of Reading and was organised by the Ministry of Agriculture and Fisheries on behalf of the Organisation for European Economic Co-operation under arrangements with the United States Foreign Operations Administration.

The course assembled at the Ministry of Agriculture and Fisheries, in London, on March 19. The opening address, ' British Agriculture—Its Structure and Main Problems,' was given by Mr. W. B. Mercer, C.B.E., M.C., B.Sc. (Agric.), N.D.A., Provincial Director West Midland Province, National Agricultural Advisory Service. The remainder of the course took place at the University of Reading.

Among the participants of the course were experienced advisory personnel engaged in providing advice on farm management and farm economics to farmers; specialists in farm management and farm economics who support the advisory activities of field workers; and persons in the European countries responsible at the national level for the direction of farm management advisory services.

The course considered the interpretation and use in advisory work of economic data resulting from research in farm management, the use of economic analysis as a means of identifying faulty management, and the application of economic principles in farm planning.

The programme included the following topics:—

1. The planning of production programmes on the farm.
2. The economic use of resources in farming.
3. The recording and analysis of economic data relating to the individual farm.
4. The training of personnel for farm management advice.
5. Integration of research and advisory services.
6. Methods of presenting management advice to farmers, with special reference to individual advice, pilot and demonstration farms and group techniques.

Moving the Groundnut and Cotton Harvests of Northern Nigeria

IN recent times, one of the 'sights' of Kano has been the serried ranks of symmetrically constructed pyramids of groundnuts. Symbolically, these pyramids represent wealth and prosperity to the North for they result from two bumper crops of groundnuts. Their presence, however, also reflects the magnitude of the problem of transporting them to the ports of shipment.

The present season's crop promises to match and even exceed the two previous record crops. As a result, for a time, even more pyramids will have to be built.

The groundnut pyramids

But although the groundnut pyramids attract the limelight of publicity, they are not alone in their imprisonment in the North awaiting release for their long journey to the ports for shipment and sale in overseas markets. Cotton, second only in importance to groundnuts as a revenue earner to the North, is also increasing in production and the ginned products, cotton lint and cotton seed, have to wait many months before they can be railed to the port, thereby causing considerable congestion at the ginneries. The method of storage of these products, though less spectacular, is, by the nature of these products, fraught with many difficulties. For instance, cotton seed is liable to spontaneous combustion when stored in dumps in the open and needs careful housing. Last season, a considerable quantity of cotton seed was lost through this cause. It should be noted, however, that in contradistinction to groundnuts there is not normally any carry-over of cotton lint and cotton seed stocks from one season to another.

Everyone is aware that the reason why this produce accumulates in ever increasing quantities is that existing transport facilities are unequal to the task of moving them to the ports.

In the case of groundnuts some idea of the immensity of the problem may be gained from the following figures:—

PRODUCTION FOR EXPORT

Crop Year	Kano Area (tons)	Rivers Area (tons)	Total (tons)
1951-52	400,594	24,994	425,588
1952-53	401,941	29,535	431,476
ESTIMATE OF PURCHASES FOR EXPORT			
1953-54 season ..	450,000	30,000	480,000
TONNAGES CARRIED OVER			
Oct. 31, 1952 ..	124,232	5,533	129,765
Oct. 31, 1953 ..	186,093	9,949	196,042
Oct. 31, 1954 (estimated)	146,000	10,000	156,000

Their effect and their reason

The accumulation of these heavy stocks in the North creates a major storage commitment. A carry-over of stocks from one season to another means that two crops are being shipped at the same time and this greatly adds to the work of stocking, accounting and general administration. The financial implications are, however, still more serious. The capital needed to finance current purchases and unrailed stocks absorbs the bulk of the Groundnut Marketing Board's reserves. This is best illustrated by the fact that at the end of next March the Board will have approximately £15 million tied up in stocks of groundnuts. Prolonged storage also involves the Board in heavy additional costs due to, *e.g.* loss in weight, carrying charges, tarpaulin costs, pest infestation measures and physical losses through deterioration. These are estimated to total about £3 15s. per ton, or £1½ million on a 400,000-ton crop. In the final analysis, the losses resulting from delay in evacuation are borne by the producers.

River transport

While it is on the railway that groundnut evacuation to port primarily depends, the maximum possible use is made of Nigeria's natural means of communications provided by the Rivers Niger and Benue. The Rivers Area production of groundnuts is evacuated by river fleets on the Upper Niger and Benue and the Lower Niger to Warri and Burutu, but the maximum possible quantities of Kano Area groundnuts are carried to the coast by a combination of river and rail transport, using the railway from Kano to Baro and the River Niger from Baro to Burutu and Warri. While this route affords a certain measure of relief, it cannot be regarded as being the potential solution to the main transport problem since the limiting factor is the seasonal navigability of the rivers which sets an upper limit of 45,000 tons each season. Many sand banks are formed in the rivers which make navigation difficult, and there is a bar to be negotiated on the Benue at its confluence with the Niger and at low water there are only 2 ft. of water.

The seasonal nature of the river transport presents immense problems, and any large increase in traffic by river fleets will depend on measures to improve the navigability of the Benue and the development of the Lower Niger in combination with the solution of the problem of the delta bars. These problems are at present under expert investigation.

Road transport

Another possibility is road transport but, at the moment, any major road haul-

Groundnut pyramids near Kano, Northern Nigeria

age operation of groundnuts is impracticable owing to the surface conditions and the weight-carrying capacity of the roads and the numerous bridges which have to be crossed. To build and maintain a trunk road from the North, capable of carrying heavy groundnut traffic, would involve vast capital and recurrent expenditure. The question is being examined, but it cannot be regarded as other than a long-term possibility.

The Nigerian railway

The key to the solution of this vast and complicated problem is the railway. Contrary to the belief held by some people, the capacity of the line, measured in terms of permanent way, signalling and crossing stations, is adequate to provide the requisite number of freight train paths to deal currently with all traffic offering for rail transport. The serious operating difficulties which confront the Nigerian railway are basically the lack of locomotives, which have not been adequate in past years owing to world shortages of materials following World War II. It should also be realised that in addition to having to move the cotton and groundnut crops of the North, the railway's operating capacity is being further strained by an ever rising level of internal traffic in local foodstuffs, etc., together with a steadily increasing volume of import traffic.

The increase in rail traffic

The following figures illustrate the immense increase in rail traffic in the past seven years: in 1945-46 the railway lifted a total of 1,424,843 tons, whereas in 1952-53 the traffic carried by rail amounted to 2,086,000 tons. Expressed in terms of net ton miles, these figures represent 429 million tons miles in 1945-46 and over 827 million ton miles in 1952-53—an increase of nearly 100% over the seven-year period.

The shortage of locomotives

During that seven-year period, 96 new engines were supplied to the railway.

The prospects of the railway obtaining its essential requirements of locomotives and so overcoming these operating difficulties are encouraging. Twenty-seven additional main line steam locomotives ordered in 1952 were due to arrive in Nigeria by March 1954. Six have already arrived and are now in service; nine were due to arrive before the end of January 1954 and specific ships for the balance of the 27 have been provisionally fixed. A further 15 are expected in November or December 1954 making a total of 42 additional main line steam locomotives. To provide an additional safety margin, ten diesel electric locomotives have been ordered, the first delivery of four of which is expected in November 1954 and thereafter at the rate of one a month. These ten diesel electric locomotives have a traction power equivalent to 21 of the standard main line steam locomotives now in use; moreover, they will ease considerably the watering problem for steam locomotives which all too frequently curtails railment during the dry season in the North.

Other improvements

The railway workshops and repair organisation are being extended and improved and these measures are resulting in a greater serviceability of locomotives. The daily average of engines out of service in the running sheds has already fallen from an average of 40.9 during 1952-53 to a current figure of about 20. Improvements to signalling installations and the remodelling of the marshalling yards are also in hand as well as plans for the speeding up of coaling of locomotives.

This notable increase in locomotive power and in the general operational efficiency of the railway will call for a speedier turnround of wagons at both the loading and discharging ends so as to ensure that the increased power and efficiency are utilised to the maximum advantage. To this end special arrangements are being made at Kano to speed up handling and loading of the groundnuts by the completion in 1954 of at least one additional berth at Apapa and at Port Harcourt by four additional export sheds, together with the installation of mechanical equipment for loading to ships.

The immediate results of the progressive increase in locomotive power, combined with the effect of the complementary measures, is reflected in the railway's railing programme for the period November 1953 to October 1954. This provides for a lift of 490,000 tons of Nigerian groundnuts, which represents an increase of 123,000 tons over the programme figure for 1952-53.

That railings of groundnuts in recent months have not only equalled but even exceeded the programmed monthly figures is evidence that the programme is conservatively framed.

The outlook

As additional locomotives are received and put into commission the monthly rate of groundnut railings should continue to increase. By the end of the period covered by the current railment programme, *i.e.* October 1954 the rate of groundnut railings is put at the figure of 51,000 tons per month, or 612,000 a year. On this performance the railway should be able to clear the estimated carry-over at October 31, 1954 of 146,000 tons of 1953-54 crop groundnuts and carry the whole of the 1954-55 season's groundnut crop before the harvest of the 1955-56 crop commences.

It will be seen, therefore, that the problem of evacuating this vital product of Northern Nigeria is being tackled with energy and determination and that, saving unforeseen difficulties, the measures which have been initiated give every promise of proving successful.

(*Nigerian Government statement.*)

Photo: B.O.A.C.

WORLD CROPS

IN OUR NEXT ISSUE P. H. Southwell will be writing on **Mechanical Handling,** while **Fish Culture** will be discussed by Eli Schwartz. **Olive Fly Control Investigations in Italy and Greece** will be discussed by C. Logothetis, and the **Sugar Industry in India** will be described by S. Ramanath. There will also be additional articles and the usual features.

Caterpillar Dealers' Charges

A number of new export dealers and territory reassignments have been announced by Caterpillar Tractor Co., affecting territories in the Middle East and North-eastern Africa. The new dealers include Paul Ries and Sons Ltd., of Crater, Aden, distributor for British Somaliland, Aden Colony and Protectorate, including Hadhramaut; Paul Ries and Sons Ltd., distributor for the territory of Ethiopia and Eritrea; and Aciens Comptoires Ries of the territory of French Somaliland.

Dealers affected by territory reassignments are John Birch and Co. Ltd. and Mohamed Nahmood Zahid and Bros. The territory of John Birch and Co. Ltd. now includes the neutral zone between Iraq and Saudi Arabia, the neutral zone between Kuwait and Saudi Arabia, a strip 50 miles wide following the east coast from the neutral zone in the north to Trucial Oman in the south and the Arabian American Oil Co.

The territory of Mohamed Mahmood Zahid and Bros. now includes all of Arabia except the strip 50 miles wide following the east coast of the Persian Gulf now included in the territory of John Birch and Co. Ltd.

The Special Rice Meeting at Bangkok

IN pursuance of the resolution of the 1951 FAO Conference on the problem of rice supplies and its subsequent endorsement by the FAO Council, a special rice meeting was convened in Bangkok, Thailand, from January 5 to 16, 1954 to make a study of the economic factors that affect supplies, distribution and price of rice in the main producing and consuming areas. The meeting was attended by delegations from Australia, Burma, Ceylon, Cuba, France, Germany, India, Indonesia, Italy, Japan, Korea, Laos, Netherlands, Pakistan, Philippine Republic, Portugal, Saudi Arabia, Spain, Thailand, United Kingdom, United States and Vietnam, and observers from ECAFE and the International Bank for Reconstruction and Development.

The recommendations of the meeting are summarised below:

Economic incentives to increase rice production

Price policies

1. That all member governments operating price policies review these so as to ensure that they do definitely encourage production and do not represent a burden on the community incommensurate with the benefits derived.

2. That governments in reviewing price policies collect more data on production costs.

Subsidies

3. That Governments review their subsidy programmes in the light of the considerations urged in the report.

Agricultural credit

4. That governments should set up credit facilities or expand their present programmes.

5. That FAO should consider the desirability of extending the study of agricultural financing, including agricultural credit, by seminars or other suitable means in the Far East.

6. The FAO give priority to requests from member governments for technical assistance in setting up national programmes for agricultural credit.

7. That governments investigate (*a*) the proportion which producers receive of consumer rice prices; (*b*) the marketing processes, to determine which steps could be rendered more efficient; and (*c*) improved methods of marketing administration.

8. That governments encourage the development and expansion of co-operative organisation to this end.

Land tenure improvement

9. That governments review current tenancy regulations with the object of making equitable provisions regarding periods of lease, restrictions on ejectments, amount of rents, type and term of payment, machinery for supervision and for the settlement of disputes.

10. The FAO give technical assistance to member governments in investigating legal and other phases of land tenure.

11. That results of investigation at present being carried out by FAO into land reform be made available to member governments.

Land settlement

12. That governments conduct surveys for the exploration of land suitable for rice cultivation and develop plans for the settlement of farmers on them.

13. That FAO assist countries in carrying out the above recommendation.

Improving distribution

Organisation for collection and distribution

14. That member countries give careful thought to the possibilities of improving organisations for collecting, distributing and handling exports and imports of rice.

15. That information relating to the methods of each organisation be interchanged so that all member countries may have the opportunity of deriving benefit from the experience of others.

Grading and standardisation

16. That member countries expedite the establishment of standards for grading paddy and rice.

17. That FAO assist interested countries by supplying information regarding equipment which may be used to determine qualities of rice.

18. That FAO assist interested countries in the adoption and use of standard grades and the operation of an effective grading service.

19. That a small panel of experts on rice grading be formed to explore the possibilities of establishing uniform standard grades on an international level.

Inspection and quality control

20. That exporting and importing countries should concert mutually acceptable arrangements in this regard.

21. That inspection services be made available at the principal assembly points in commercial producing areas.

22. That FAO assist interested governments in training qualified personnel for inspection work.

Storage and handling

23. That an analysis of the economics of different types of storage should be undertaken by member governments.

24. That governments approach FAO for advice and assistance in their programmes of storage development and personnel training.

25. That countries should consider the establishment of market credit facilities for paddy or rice in storage as security to help to eliminate seasonal fluctuations in price.

Processing

26. That each country undertake an economic study of rice milling with a view to its improvement.

27. That countries should make more efficient use of rice by-products.

28. That countries should make studies of the effects of decentralisation of rice milling on food supplies.

29. That, in view of higher yield and nutritional quality, member governments should encourage the production of undermilled rice.

30. That member governments be requested to extend the use of parboiled rice for its nutritional value and higher outturn.

31. That FAO assist member governments in matters of rice processing.

Transport

32. That long-term production plans should make provision to increase internal transportation facilities to ensure a smooth flow of movements.

Market intelligence

33. That rice market news services should be established in each member country, where they are not in existence, as an integral part of a market intelligence programme.

34. That all rice importing and exporting countries co-operate with FAO in supplying information for compilation, analysis and distribution.

35. That, whenever practicable, countries should arrange for exchange of rice market information.

Other recommendations

Production and use of subsidiary food crops

36. That FAO should assist member governments in the exchange of seeds for experimental purposes.

37. That governments should develop suitable methods of processing alternative foods to make them more acceptable to rice eaters.

38. That governments should encourage consumption of cereal foods other than rice through nutritional education programmes.

39. That FAO should assist member governments in developing these programmes by giving technical assistance.

Fish culture

40. That countries should consider the possibility of introducing fish culture in rice fields.

Technical assistance

41. That FAO provide, as soon as possible, reports on the results from their Expanded Technical Assistance Programme in terms of increases in production, savings made through improved storage, processing and marketing and improvement in nutrition.

International rice trade

The meeting did not feel able to make recommendations regarding international trade in rice, or to suggest any plan for directing international trade.

Future consultations on rice problems

The meeting also did not feel able to suggest when a further meeting should be held, as much would depend upon the progress achieved by member governments in putting into operation the recommendations of the present meeting.

Hay Drying in Scotland

The annual report of the North of Scotland Hydro-Electric Board for 1953 shows that the Board continued to develop and encourage the use of electricity as a means of securing a better grass and hay crop in the comparatively wet conditions which prevail in the north and north-west of Scotland. The type of drier with fans and heaters which the Board finally decided to develop, operated successfully at seven farms located at Braco (Perthshire), Windyedge (Perthshire), Georgetown (Ballindalloch, Banffshire), Cullisse (Nigg, Rossshire), Acharn (Duror, Argyll), Keppoch (Roy Bridge, Inverness-shire) and Plockton (Ross and Cromarty).

The hay drier at Plockton was run on a community principle for six crofters, and all the crofters were satisfied with the results. The hay season was exceptionally wet there and had it not been for the electric drier, some of the crofters would not have been able to secure their crop. The cost of electricity used in drying the hay at Plockton was approximately £6 13s. a ton load, and if the annual charges on the drier are added the total cost per ton was about £10 to £12. The crofters brought the hay to the drier and took it away again. The protein content of the hay ranged from 8% to 12%, the samples with over 10% protein being highly satisfactory for that area.

CORRESPONDENCE

Insecticide Equipment

TO THE EDITOR

Dear Sir,

Each reputable and progressive manufacturer of machinery for applying pest control chemicals is in agreement with the views expressed by Mr. Hope in his letter of January 20. There are, however, two great impediments to putting into practice this excellent policy.

Firstly, a spraying machine must do two things. It must go and it must do its job. The greater emphasis is placed on the mechanical reliability of the piece of machinery which, although important, is easy to obtain and too little thought is given to whether or not it is doing the work required of it in depositing, in a suitable form and where it is required, the pesticidal material. The two reasons for this which we hope to remove are (1) the user of the machine is often quite content with its performance providing it does not block, break or wear out and (2) there is, in my opinion, and I think the majority of biologists would not quarrel with this view, insufficient precise and quantitative data on just what is required from a spraying machine, fog generator, duster and so on for each of several chemicals against a variety of pests on numerous hosts.

Secondly, it is a very difficult, expensive and laborious task to obtain just this information. Therefore a machine is usually sold without receiving a complete endorsement of suitability and this state of affairs can only continue. However much more should be done to ensure that any machine is not grossly unsuited to the purposes for which it is claimed to be ideal.

The best that can be managed in future is to aim at the proper method of working as closely as is deemed necessary and economic for the purpose in hand. It is notable how a cautious, scientific programme aimed at obtaining research results follows the same pattern and lines of reasoning as a project designed to produce sales of machinery. With the very large and able resources we can call upon we cannot always use this ideal method in designing our experimental spraying machines—there is not enough time—so it is certain that a manufacturer must also limit strictly the amount of effort spent on prior consultation with the chemists and the biologists.

Despite the obstacles to its employment, Mr. Hope's main thesis that (1) closer integration of the work of the biologist, chemist and engineer and (2) proper utilisation by the engineer of the information available to help him design his machines properly are both essential, cannot be contradicted.

Yours faithfully,

R. J. COURSHEE.

National Institute of
Agricultural Engineering,
Wrest Park, Silsoe,
Bedfordshire.
March 13, 1954.

The half-millionth Fordson tractor to be produced at Dagenham is driven off the assembly line by Mr. H. H. Jeffries, the general works manager. The first Fordson tractors were imported from America in 1917. Later they were produced at the Ford plant at Cork, and in 1932 production was transferred to the new factory at Dagenham

NEW BOOKS

Plant Life in Malaya

By R. E. Holttum. Pp. viii + 254. London. Longmans Green. 1954. 18s.

Prof. Holttum, having spent 31 years of his life in Malaya, first as director of the Botanic Gardens in Singapore and latterly as professor of botany in the University of Malaya, is obviously particularly well qualified to write about the flora of the Malaya Peninsula. The present book is apparently designed to give a fairly elementary introduction to some of the more striking features characteristic of plant life in that country, which, as Dr. Holttum points out in his preface, is more than ordinarily complex, partly because there are such a large number of plant forms and partly because the Malayan climate with its characteristic high temperature and humidity tends to evoke very varying responses from different plants to the climatic conditions.

After an introductory chapter on the relationships between plants and climate there follow a series of chapters on the morphology of various plant forms, followed by a short chapter on vegetative propagation; subsequently, there are chapters dealing with the habits and behaviour of a large number of Malayan plant forms, including grasses, bananas, orchids, ferns, climbing plants and parasites and saprophytes.

Towards the end of the book there is an interesting and arresting chapter on the interrelationship of plants and ants, which in view of the importance which the ant is now assuming in relation to the transmission of plant disease, one wishes could have been extended. The last chapter in the book deals with conditions in the Malayan forest, and brief though it is, is perhaps the most intriguing in the book.

The book is illustrated with a number of line drawings and with a frontispiece portraying conditions in the Malayan jungle at Cameron Highlands at an altitude of 4,700 ft. The book is packed with information, much of which is new and is drawn from the stores of Dr. Holttum's wide experience.

It is not easy to see to what audience it is specifically addressed. It is stated in the author's preface that it is hoped that it will be useful to a variety of people, notably residents in Malaya who wish to commence the study of Malayan plants, and it is also stated that it is hoped it will be useful to teachers without special botanical knowledge, as well as to first-year students at the University. This is, however, a very limited range, to the reviewer it seems that while it is certainly not a textbook in the strict sense of the word, the book could be read with pleasure and profit by the student of botany as a supplement and extension to standard textbooks, inasmuch as it is packed with information which does not normally find a place therein. It should also be of interest, as the author claims, to the large number of non-scientific people who are interested in plants in Malaya, and who, thanks to Dr. Holttum's easy narrative style, will find that the contents of the book are capable of absorption with the minimum of mental strain and the maximum of profit.

H.T.

Wine Growing in England

By George Ordish. Pp. 128, illustrated. Rupert Hart-Davis 1953. 7s. 6d.

The many friends of Mr. George Ordish may be somewhat surprised to see that in his latest book he has forsaken the subject of economics in regard to pest control and has come forward as the author of this little book on wine growing in England. It transpires, from the preface, that in his earlier days Mr. Ordish had experience as an entomologist among the vineyards of France and was struck with the fact that in many vine-growing districts the climate was not so very different from our own. Apparently, on his return to this country he started experiments in the making of wine, which he has carried on for many years and the results of which are included in the book. He writes as an enthusiast and in the short compass of the 128 pages of this book he gives clear instructions which if the aspiring viniculturist and wine maker follows will enable him to produce wine in Great Britain. An incitement for the would-be producer in England is that, whereas excise tax on light still wines, containing 15% alcohol, is 10s. 6d. per gallon, the home wine maker does not have to pay this duty *provided he does not sell his wine.* He is therefore free to consume and give away all this wine which, as Mr. Ordish himself points out, means that he starts with an advantage of 1s. 9d. a bottle. The book itself is well produced and fully illustrated with many excellent photographs, including one of the author and his family reaping their own harvest.

Control of Red Spider Mite

Since 1944 the Pettar Society of Winter Wash Manufacturers, the Associated Fruit Growers of Essex Ltd. (Ace Growers) and the Agricultural Research Council have jointly organised and financed investigations into the commercial control of the fruit tree red spider mite. Ace Growers and the Essex Institute of Agriculture have provided plantations for experiment, labour and machinery; the Pettar Society have furnished chemical materials, some scientific and the recording staff; and the Council have provided (through East Malling Research Station) scientific staff and laboratory facilities. The work has been planned and co-ordinated by a joint conference of the three organisations.

The first stage of the investigations was devoted to the trial of winter washes, but these by themselves were found not to give a sufficient degree of control. Since 1949 the investigations have been concentrated on the use of summer acaricides and ovicides, including derris, parathion, diphenyl sulphone (DPS), chlorphenyl benzenesulphonate (CPBS) and chlorphenyl chlorbenzenesulphonate (CPCBS). It has been found possible to obtain effective control of the red spider mite by a single application of DPS, CPBS or CPCBS as an ovicide when applied with a suitable acaricide. By observing proper precautions, with due regard to variety, spray damage to trees and fruit can be eliminated or reduced to a minimum.

In view of the success which has been attained, it has been decided that it is not necessary to pursue the collaborative investigations further. Arrangements will be made by the Agricultural Research Council for publication of a full account of the work.

Technical News

The main articles of the May issue of *Petroleum* are ' Simple Corrosion Theory as an Aid to Materials Selection—2 ' by Dr. T. K. Ross, ' Trends in Modern Viscometry—1 ' by E. G. Ellis, and ' Petroleum Additives—1 ' by C. O. Tongberg, N. V. Hakara, L. E. Moody and J. B. Patberg.

The following articles appear in the May issue of *Food Manufacture:* ' Description of a Chicago Biscuit Factory '; ' Gyratory Vibration in the Development of Sieving '; and ' Progress in Packaging in 1953.'

Among the articles appearing in the May issue of *Paint Manufacture* are ' Pentaerythritol Drying Oils as Paint Media '; ' Printing Inks for the Electronic Industry '; ' The History of Paint and Varnish in Great Britain—4 '; and ' Technical Aspects of Primer Failures on Exterior Woodwork.'

REPORTS AND PUBLICATIONS

Farm Incomes in England and Wales—No. 5

This report, published by H.M. Stationery Office, is the fifth in the series prepared by the Ministry of Agriculture and Fisheries on the results of the Farm Management Survey in so far as it relates to farm incomes and expenditure. In it the financial results of farming for 1951-52 are compared with those for 1950-51 on the basis of a sample of 2,262 farms located throughout England and Wales and grouped according to type of farming and size of farm.

The Farm Management Survey Scheme is carried out by agricultural economists at ten centres attached to universities and agricultural colleges. It provides each year information which is helpful for local advisory work, research and teaching purposes, and in dealing with many of the problems connected with the agricultural industry.

The substance of the fifth report is similar to that of the earlier ones, consisting of a short explanatory text followed by numerous tables showing the variation of net income with type and size of farm, gross and net output and details of revenue and expenditure. A few tables have been modified in an attempt to present the results and to reveal relationships more clearly.

The report will be of interest to the farmer, the student of farm management and agricultural economics, and to all who are in any way concerned with the development of the agricultural industry.

Index of Agricultural Research in in Great Britain. Progress during 1953-54

This is the second edition of the *Index of Agricultural Research in Progress*, first published in 1951. Valuable suggestions made by users of the first edition have now been adopted. No alteration has been made in the general arrangement by which the information is listed in two ways: first, in a classified subject index, bringing together items in the same fields of enquiry; and, secondly, in animal and crop indexes listing researches directed towards improved production in particular classes of farm livestock and crops.

The index now covers practically all State-aided agricultural research financed by the Agricultural Research Council, the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland. As well as the work of the research institutes, this second edition of the index includes long-term experiments of the experimental husbandry farms and horticulture stations, the National Agricultural Advisory Service field experiments, and the investigations of the Scottish agricultural colleges.

Report of the Recommendations Sub-Committee of. the British Weed Control Conference, 1953

This booklet summarises recommendations for the use of chemical weedkillers in British Agriculture, and has been issued by the Council of the British Weed Control Conference. It is the unanimous report of a committee representing the Ministry of Agriculture and Fisheries, the Agricultural Research Council, the National Farmers' Union, the Association of British Insecticide Manufacturers and the British Agricultural Contractors' Association. It was accepted by the first National Weed Control Conference held in November 1953.

The first half of the report classifies the susceptibility of 174 agricultural and turf weeds to MCPA, 2,4-D, DNC and dinoseb (DNBP). The second gives recommendations concerning the type and amount of weedkiller (herbicide) to use for selective weed control in field and vegetable crops.

Dr. E. M. Crowther

It is with profound regret that we record the death on March 17 of Dr. E. M. Crowther, Deputy Director and Head of the Chemistry Department at Rothamsted Experimental Station, at the early age of 56.

To the readers of WORLD CROPS Dr. Crowther's name will be well known and he had acquired a world-wide reputation as one of the leading authorities on the subject of fertilisers and soils in the United Kingdom. He was a graduate of the University of Leeds and went to Rothamsted immediately after graduating, becoming the Head of the Chemistry Department in 1927 and Deputy Director in 1950. During the course of his career he travelled widely and paid many visits to overseas countries, including both East and West Africa. His last journey was to the Sudan and East Africa at the end of 1953.

He will long be remembered as a brilliant and lucid lecturer. His last effort in this direction was the Jubilee Memorial Lecture for the Society of Chemical Industry which he delivered not long before his death. He will be greatly missed in all scientific circles concerned with fertilisers and the maintenance of soil fertility.

R.A.S.E. Gold Medal Award

The council of the Royal Agricultural Society of England agreed unanimously at a recent meeting that the Society's gold medal for distinguished services to agriculture should be conferred on Sir John Russell, O.B.E., D.Sc., F.R.S., in recognition of his contributions to soil science and food production.

The council also agreed that honorary fellowship of the Society should be coupled with the award of the medal.

Under the terms of the Society's new constitution (adopted February 25, 1953) up to 50 persons whom the council regard as having rendered exceptional achievements to agriculture or attained high achievement in farming operations may be elected as honorary fellows of the Society.

An honorary fellow holds the position for life, is not called upon for the payment of subscription, and may attend and speak at meetings of the Society.

The council has also agreed that surviving holders of the Society's gold medal for distinguished services to agriculture should be appointed honorary fellows. These are (with dates of the award): Sir Merrik R. Burrell, Bt., C.B.E. (1938), Sir George Stapledon, C.B.E., F.R.S. (1939), Lord Courthope, P.C., M.C. (1942), Viscount Bledisloe, P.C., G.C.M.G., K.B.E. (1947), and Sir Roland Burke, K.C.V.O. (1950).

The Society's selection committee is considering further proposals for appointment as honorary fellows, although there is no immediate intention of electing the maximum number.

The election of 247 new members and 14 governors brought the Society's present total membership to 15,171.

The Lille International Trade Fair

The Lille International Trade Fair will take place between May 1 and May 16, 1954 and is open to industries all over the world. It is held in the heart of the northern region of France, one of the most important agricultural and industrial areas in the northern countries, and is conveniently situated for conferences and exchanges of views between members of the principal European nations.

The Fair occupies a superficial area of about 240,000 sq. yards. The Grand Palace is known practically all over the world, covering about 1 hectare on one single piece of ground. About 3,500 exhibitors appear every year, including firms of about 15 different nations, while 1½ million visitors are admitted annually.

FARM MACHINERY

French Agricultural Machinery Show

(From a Correspondent)

The 26th International Agricultural Machinery Show, held in Paris in the first week of March, was an eye-opener for many who had not realised that the French in the years since the war have created what is probably the world's finest show of power farming machinery. This show was only revived in 1946, after six years of German occupation, in a country where less than 10% of the farmers have ever used a tractor or harvester; it now surpasses in size both our own Royal and the Smithfield Shows.

Seven large exhibition halls and a vast outdoor area covering 125 acres housed tractors, implements and dairy equipment produced by 1,000 French and 225 foreign exhibitors from 14 different countries, including those behind the Iron Curtain. Ten thousand British visitors, including many farmers, agricultural engineers, dairymen, dealers and contractors, were surprised to find that the speedy service of Air France, which put them down at Orly airport, only a few miles from the showgrounds, had practically made this show a day trip from London.

German tractors

The greatest surprise of the show was that the German sector has now become the largest after the French, with Britain in third position. The Germans have certainly left no stone unturned to capture this market and were represented in every sphere. The greatest sensation was probably the range of the new Allgaier diesel tractors, which are available in five sizes of 11, 16, 22, 33 and 44 h.p., and have the tremendous advantage that 76% of their parts are interchangeable. The same firm also presented the first power-driven trailer which, with a four-wheel drive from the power take off, can take a load of 2 tons up a hill with a gradient of 37° and at the same time tackle the roughest surface. These German tractors are all priced low enough—£670 for the 11 h.p., £732 for the 16 h.p., and £922 for the 22 h.p. type—to enter into serious competition with the most popular British tractor on the Continent, the Ferguson. Not that these German attempts to shatter British supremacy should spell immediate danger, for Fergusons, who have now joined forces with Massey Harris, can offer a wonderful after-sales service.

Development of mechanisation in France

France is at last bestirring herself to mechanise her farms. The number of tractors now in use is 235,000, against 180,000 this time last year. This means that the halfway mark has been reached, for the official target of the French Ministry of Agriculture is 450,000. It may be many more years before this is reached for the real tragedy in French agriculture lies in the fact that the farmer gets less for his produce than elsewhere, whilst machines cost him about a third more. Steadily rising wages—higher than in Britain—higher prices for clothes, shoes and household articles, and the galling knowledge that about half a dozen ' middlemen ' take a ' cut ' must indeed make the French farmer wonder whether Mr. Stanley Evans may not be right after all with his ' featherbed ' theory about British farmers.

The Bristol 22 tractor was exhibited

British machinery in France

Britain, however, still supplies most of the tractors, small cultivators, tyres, harvesters and dairy equipment used in France. Thus Fergusons designed a special narrow-gauge vineyard tractor, Massey Harris supplied the first rice combine harvester for the Camargue in the Midi, while the new government dairy farms are all fitted with Gascoigne auto recorders. The model farm in the show is, in fact, simply studded with equipment ' Made in Britain.'

But the French can still teach us a few things, particularly where design and choice of materials are concerned. Their problems are different; for instance, a constant watch has to be kept on the weight of a new machine, in order that when a tractor is not available it can be horse, mule, donkey or ox drawn.

New French machines

Several of this year's ' Machines Nouvelles ' were outstanding. The new Bonnel hydraulically-operated tool bar for instance, the compressed air grain blower and sorter shown by Socama, Wintenberger's new combine harvester with a pick-up baler attachment all on one level, or the reaper

A general view of the exhibition

(*Top*) **Some of the stands in one of the seven exhibition halls.** (*Below*) **A view of the Firestone stand**

binder made by Heywang of Bourgheim (Bas Rhin).

Among the most admired of the French machines, however, was the electro-magnetic sugar-beet gapper shown by Magnier of Ouchy; costing just under £400, it can eliminate the long back-breaking job of singling young sugar-beet plants. Doing three rows at a time, it can tackle 2-3 acres a day and is easy to operate.

Another very clever machine is the Stromboli compressor made by Sferi-Coanda of Clichy (Seine) which, powered by only a 2 h.p. petrol engine, can spray fruit trees, vines or field crops within a radius of 7 yards, and by only a slight adjustment the same machine can be used to broadcast rice seed.

Prices

Although the motto of this year's show was ' Produire Mieux et Produire Moins Cher ' only the nationalised Renault tractors seemed to have taken it seriously. Their prices were cut by 10%, whereas all the others had found it impossible to ' produce cheaper.' There is, however, a glut of new French tractors. To mention only two new light ones, Bergerat Monnoyeur of Paris were showing the B.M. 1200 a four-wheel drive 12 h.p. tractor with an air-cooled diesel engine, whereas the Compagnie General Mechanique had their new Percheron 15 on view for the first time. The name of the latter is particularly well chosen, for it is that of the most popular breed of horses in France, and one wonders why no British manufacturer has yet thought of calling a new tractor the ' Suffolk Punch ' diesel.

Among British tractors Fordsons have now developed a narrow-gauge vineyard tractor for the French market, while among the most popular British light crawler tractors in France are the Bristol 22 and Ransome's M.G.6. The Massey Harris ' Pony ' diesel continues to sell extremely well, and to mention tractor tyres, Firestone and Avon put up a good show against their only serious French rival Kleber-Colombes.

Conclusion

In everyone's opinion the Paris Show has now become a ' must ' for all interested in the progress of power farming, for quite apart from being the biggest in the world in size and in the number of exhibitors, it is also well organised, laid out and planned.

John Bean Distributors

Varley Pumps and Engineering Ltd., of Brentford, who are associated with the Food Machinery and Chemical Corporation of Michigan, and the John Bean Division of Lansing, U.S.A., have appointed E. Allman and Co. Ltd. sole distributors for the British Isles and certain overseas countries for John Bean spraying machinery and pumps, etc., for the agricultural, horticultural and allied industries.

Under this agreement Messrs. Varley Pumps and Engineering Ltd. are manufacturing the pumps and the Allmans are manufacturing the remainder and assembling the machines. The first machine to be put into production is the John Bean Spartan Power Sprayer. This is equipped with a Royalette twin cylinder piston pump with a capacity of 3½ gal. per min. at 400 p.s.i., a prototype of which was on view at the Smithfield Show.

Other models, including the well-known Royal range of John Bean sprayers, will shortly be available. This information will be of particular interest to fruit growers and others who are interested in high pressure quality sprayers. A range of fruit-grading and other machinery will also come into the production programme and prices will be very competitive indeed. The new range of John Bean piston pumps are now designed to run at tractor power take off shaft speeds.

New Dunlop Tyre

The Dunlop Co. have announced a new 6 by 19 six-ply rated front tractor tyre in their tractor tyre range to satisfy the need for a heavier front wheel equipment for those tractors where fore loaders or front loaders are used.

Fire Extinguisher

Nu-Swift Ltd., the fire extinguisher manufacturers, are marketing a new type of pressure-operated extinguisher in which chlorobromomethane, the new fire-fighting chemical, is held with absorbed carbon dioxide under constant pressure. This is claimed to be the first British-made extinguisher in which use is made of the fire-fighting properties of chlorobromomethane and details are given of tests carried out on a petrol fire 2 sq. ft. in size on which an old-fashioned quart size Nu-Swift hand pump holding carbon tetrachloride, after 40 seconds pumping failed to extinguish the fire, while the pressure-operated chlorobromomethane extinguisher, of the same size, put out a similar fire in 1½ seconds. This new extinguisher is marketed under the trade name of ' Chloro-Flash.'

WORLD CROP REPORTS

WORLD

Rice prospects. Although world rice production in 1953-54 will probably be slightly higher than in 1952-53, there have been two very different developments: on the one hand, notable production increases in some rice-growing countries; on the other hand, a sharp fall in Japan's rice crop. Reports from mainland China are conflicting. Some Far Eastern countries are thought to have reaped considerably more than in the previous year, *e.g.* Burma, India, Pakistan, South Korea, and Thailand; but Ceylon, Indonesia, and Viet-Nam are all estimated to have had better outturns.

In most countries the expansion of the area sown to rice was an important factor. The largest absolute increase in rice acreage is probably that of India where it is thought to amount to about 800,000 additional hectares (about 2%). Within India itself this expansion was unevenly spread, being highest in Uttar Pradesh and West Bengal, where the reduction in the jute acreage was an important factor, and least in Bihar, the state with the largest rice acreage. Bombay and Orissa will probably register slight contractions in their rice acreage. Pakistan, too, expanded its rice area considerably, the increase being estimated at 650,000 hectares (7%), mainly in East Bengal, which is largely accounted for by the enforced reduction of about 470,000 hectares in the jute acreage. Thailand is believed to have extended its rice fields by over 500,000 hectares (about 11%), Burma by 200,000 (5%), and South Korea by slightly less than 200,000 (20%).

In other regions, production estimates have been further raised for both Egypt and the United States. The damage inflicted in Italy by the very unfavourable weather conditions during harvest time seems to have been much smaller than was feared at the time, and the result is now estimated to be a crop 3% larger than in 1952. Table 1, which for 1953-54 is based largely on estimates, shows some of the crops in the Northern Hemisphere, compared with the two previous years.

TABLE 1

RICE PRODUCTION IN SELECTED NORTHERN HEMISPHERE COUNTRIES IN 1953-54, COMPARED WITH 1951-52 AND 1952-53

Country	1951-52	1952-53	1953-54 (*prel.*)
	1,000 *metric tons, paddy*		
Pakistan ..	11,800	12,416	*13,000
Japan ..	11,302	12,404	10,028
Thailand ..	7,325	6,602	*7,600
Burma ..	5,500	5,841	*6,500
Philippines	2,831	3,144	*3,200
South Korea	*2,560	*2,900	*3,100
United States	2,077	2,182	2,383
Taiwan ..	*2,040	*2,100	*2,300
Italy ..	750	863	*888
Egypt ..	620	517	630
Iran ..	360	420	500
Spain ..	285	325	387
Portugal ..	141	131	117
Turkey ..	107	158	142
France ..	70	89	68
Greece ..	56	75	67
Total ..	47,824	50,167	50,910

*Unofficial estimate.

TABLE 2

RICE EXPORTS FROM PRINCIPAL EXPORTING COUNTRIES, 1951-53

Country	*Period* (*Jan. to*	1951	1952	1953 (*prel.*)
		1,000 *metric tons, milled*		
Associated States of Laos, Cambodia, Viet-Nam	Oct.	310	216	*150
Burma† ..	Nov.	1,251	1,145	991
Thailand ..	Dec.	1,612	1,413	*1,240
Brazil	June	144	155	3
China	Sept.	*100	*100	*160
Egypt	Nov.	304	13	—
Italy	Dec.	232	275	217
United States‡ ..	Nov.	450	713	585

*Unofficial.
†Includes bran.
‡Includes exports under various United States foreign aid programmes, but excludes shipments to territories and possessions.

Trade in 1953

Milled rice exports in 1953 from the three principal rice-exporting countries in Asia are estimated to be considerably below the shipments of 2.9 million metric tons made in 1952. (In 1951 the three countries exported 3.2 million tons.) In January-November, Burma shipped 150,000 tons less than in the corresponding period of 1952, while Thailand's total 1953 exports are estimated to be 130,000 tons less than that of the previous year.

The Associated States of Laos, Cambodia, and Viet-Nam, for which returns are still incomplete, are estimated to have provided in January-October 150,000 metric tons, as against 216,000 tons in the preceding comparable period. China's exports have increased significantly.

Egypt and Brazil, normally the largest exporters in their respective regions, made insignificant contributions, while Italy exported about 60,000 tons less in 1953 than in 1952. The United States, which in the post-war years has become the third largest exporter of rice, exported during January-October 1953 nearly 150,000 less than in the corresponding period of 1952. However, if the figures are considered on the basis of the United States marketing year (August-July), exports from that country in 1952-53 have been the highest on record, totalling 789,000 tons, as compared with 782,000 tons in 1951-52 and 412,000 tons averaged during 1945-46 to 1950-51. Well over half a million tons of United States rice was sent to Asia in 1952-53.

Preliminary estimates, based on exporters' figures, show that the fall in imports was particularly pronounced for India (67%) and Indonesia (50%). Japan's imports for the first nine months of 1953 were at the same level as in 1952. Any large increase in rice imports as the result of the poor current harvest in Japan may appear in later figures.

(*FAO Bulletin of Agricultural Economics and Statistics.*)

Cotton production. World cotton production in 1953-54 is now estimated at 36.8 million bales (of 500 lb. gross), the second highest on record and exceeded only by the 1937-38 crop of 39.0 million bales. The current estimate is about 3%, or approximately 1.0 million bales, higher than those for each of the past two years. Since the issuance of the preliminary 1953-54 world estimate in October, higher production aggregating 3.5% has been reported in the important producing countries of the United States, India, Soviet Union, and Mexico.

World acreage data (lacking for many countries) indicate a decline in cotton acreage from about 84.6 million acres in 1951-52 to 81.9 million in 1952-53, and a further decline to 80.2 million in 1953-54. This decline, without a comparable decrease in production, is attributed mainly to reductions in the United States and South Brazil. Production in the United States has increased because of higher yields. In the past year, significant decreases in cotton acreage took place also in Egypt, Turkey, Pakistan, and Syria.

The 1953-54 December production estimate of 16,437,000 bales for the United States is 841,000 bales higher than the October estimate included in the last report on world production. The increased production was due primarily to beneficial late rains that broke a prolonged drought in Texas and the mid-South States, followed by unusually favourable weather during the harvest months.

Foreign production as a whole is lower by nearly 300,000 bales from 20.6 million in 1952-53 to 20.3 million in 1953-54. Incomplete information from Communist countries indicate a probable increase of nearly 400,000 bales to 7.25 million. In the non-Communist foreign cotton areas

production as a whole declined by about 600,000 bales to 13.1 million in 1953-54.

Decreases in foreign production were sharpest in Egypt, Pakistan, and Syria where cotton acreage was restricted by law in favour of food production programmes and in South Brazil where acreage was reduced because of a lack of price guarantees at the time cotton was planted and the existence of more attractive prices for alternative crops. A decrease of nearly 50,000 bales, or 7%, in production in Turkey resulted from a voluntary shift by farmers to cultivation of other commodities.

The only significant increases in foreign production were in India, the Soviet Union, and China. The increase in India was due partly to favourable weather but mainly to moderation of restrictive regulations and a revival of cotton planting following about ten years of restriction of cotton cultivation in favour of food crops. Rising mill consumption and the difficulties arising from the necessity for meeting mill requirements with heavy imports of cotton in the past three years probably were among the factors responsible for moderation of the restrictions.

Such information as is available from the Soviet Union and China indicate production is slightly higher than in 1952-53, due to improved weather in the Soviet Union and strong Government efforts in China to expand cotton cultivation to reduce the requirements for imported cotton.

The current estimate of world production is about 3.5 million bales more than the estimated world consumption in 1952-53. The level of cotton consumption is not expected to change significantly in 1953-54.

(*Foreign Crops and Markets.*)

ENGLAND AND WALES

Agricultural report. Agricultural conditions in England and Wales on March 1, 1954 have been summarised in a report by the Ministry of Agriculture. Weather conditions during February were unfavourable for cultivations and sowing, except on some light soils. Autumn-sown corn was generally satisfactory although checked by frost. Livestock were in satisfactory condition and lambing prospects were favourable. Supplies of winter keep were expected to be sufficient.

The severe frosts and snow followed by rain made the ground unfit to work and, with the exception of ploughing on some lighter soils, little field work was possible. Owing to the unsuitable condition of the land very little spring sowing was done during February.

Autumn-sown crops. Wheat was checked by frost in most districts, but generally was a satisfactory plant. Barley suffered frost damage in several districts but most of the affected crops were expected to recover. Oats looked well generally, although in many areas frosts checked growth. Rye was generally satisfactory. Beans for stockfeeding suffered considerable frost damage in many areas, especially the early sown forward plants. Reports from many districts, however, indicated that some frosted crops were showing signs of recovery.

Pastures. Leys were checked by frost and made little growth during the month, but improved with milder conditions. Permanent pastures were generally in satisfactory condition but had made no growth.

INDONESIA

Cocoa prospects. In view of the world shortage of cocoa, there will probably be a considerable increase in the acreage devoted to that product in Indonesia in the future. There are great possibilities of increasing the acreage in Sulawesi and other parts of Indonesia as well as Java.

Pre-war production amounted to 1,500 tons a year and production and exports 1949-52 were as follows:

(*in net tons*)

	Production	*Exports*
1949	853	160
1950	858	429
1951	908	251
1952	763	521

In the first 10 months of 1953 production was 1,131 tons and exports 229.5 tons, mostly to Holland and West Germany.

RUSSIA

Grain shortage. Mr. Khrushchev, the Soviet Communist party secretary, has told the U.S.S.R. that grain supplies lagged behind consumption demands. Mr. Khrushchev's warning followed a decision of the Communist party central committee plenary meeting calling for an increase of grain production for the state in the near future of between 35% and 40% over 1953. The U.S.S.R. is trying to recruit 100,000 young workers, taking many from factories, to open up 13 million hectares of new grain-producing land in 1954.

The party decision, based on Mr. Khrushchev's report, said the amount of grain which remained on collective farms after the Government quotas had been met, 'is also insufficient to supply the farms.' In 1955 the farms would have to collect between 1,100 and 1,200 million poods of grain (1 pood equals 16 kilogrammes)—of which 800-900 should be delivered to the state.

The sugar beet area was to be increased by 300,000 hectares within two to three years, oil seed by 500,000 to 600,000 hectares, and a 'great increase' was called for in the cultivation areas of orchards and vineyards. Great attention was to be paid to the improved organisation of harvesting, supply of machinery, including grain driers and harvesters, and the construction of elevators.

The party proposed that 'a plan should be presented to the Government on changing the planning system in order to give more initiative to local authorities in planning agricultural production.' The party also called for immediate increases of the area under cotton, flax and hemp in the near future. In the past three years the area under flax had fallen by 33% and the flax harvest was insufficient to supply the linen industry.

FINLAND

Rapeseed oil. Finland's production of turnip-rapeseed oil from the 1953 crop is expected to amount to 8,250 short tons, or about 25% more than in 1952-53. The 1952-53 domestic oil output was, for the first time, an important factor in margarine manufacture, providing about 25% of all edible vegetable and fish oils used in Finland. A part of the 1953 turnip-rapeseed crop of 22,000 tons has been exported, chiefly to Sweden, presumably in exchange for cheaper types of vegetable oils. Part of the margarine oil requirements are also being covered by oil extracted domestically from soya beans imported from China under Finland's first bilateral trade agreement with that country. Other imports will consist of coconut oil, whale oil and olive oil to bring the supply up to about 24,000 tons.

PAKISTAN

Flaxseed prospects. The first forecast of the area under flaxseed in Pakistan for 1953-54 is 72,000 acres as against 66,000 acres reported in the first forecast of the previous year. The increase of 9% for the current planting is attributed to favourable weather. Sowing commenced on normal dates and the condition of the crop is satisfactory. The acreage reported in the final forecast of 1952-53 was 71,000 acres from which 480,000 bushels of flaxseed were produced.

The second forecast of the area under sesame for 1953-54 is 208,000 acres, against 207,000 acres reported in the corresponding forecast of the preceding year. The condition of the crop is reported as normal.